SCIENTIFIC AMERICAN SUPPLEMENT, No. 933

Copyright by Munn & Co., 1893.

Scientific American Supplement, Vol. XXXVI. No. 933 | NEW YORK, NOVEMBER 18, 1893. | Scientific American Supplement, $5 a year.
Scientific American, established 1845. | Scientific American and Supplement, $7 a year.

THE CUNARD COMPANY'S STEAMSHIP LUCANIA.

A RECENT number of *The Engineer*, London, contains an elaborate description of this new vessel, from which we make the following abstracts:

The differences between the Lucania and the Campania, the two new sister ships of the Cunard line, mainly refer to additions to the upper plating, with a view to greater continuity of the shade deck, and consequent minimizing of vibration.

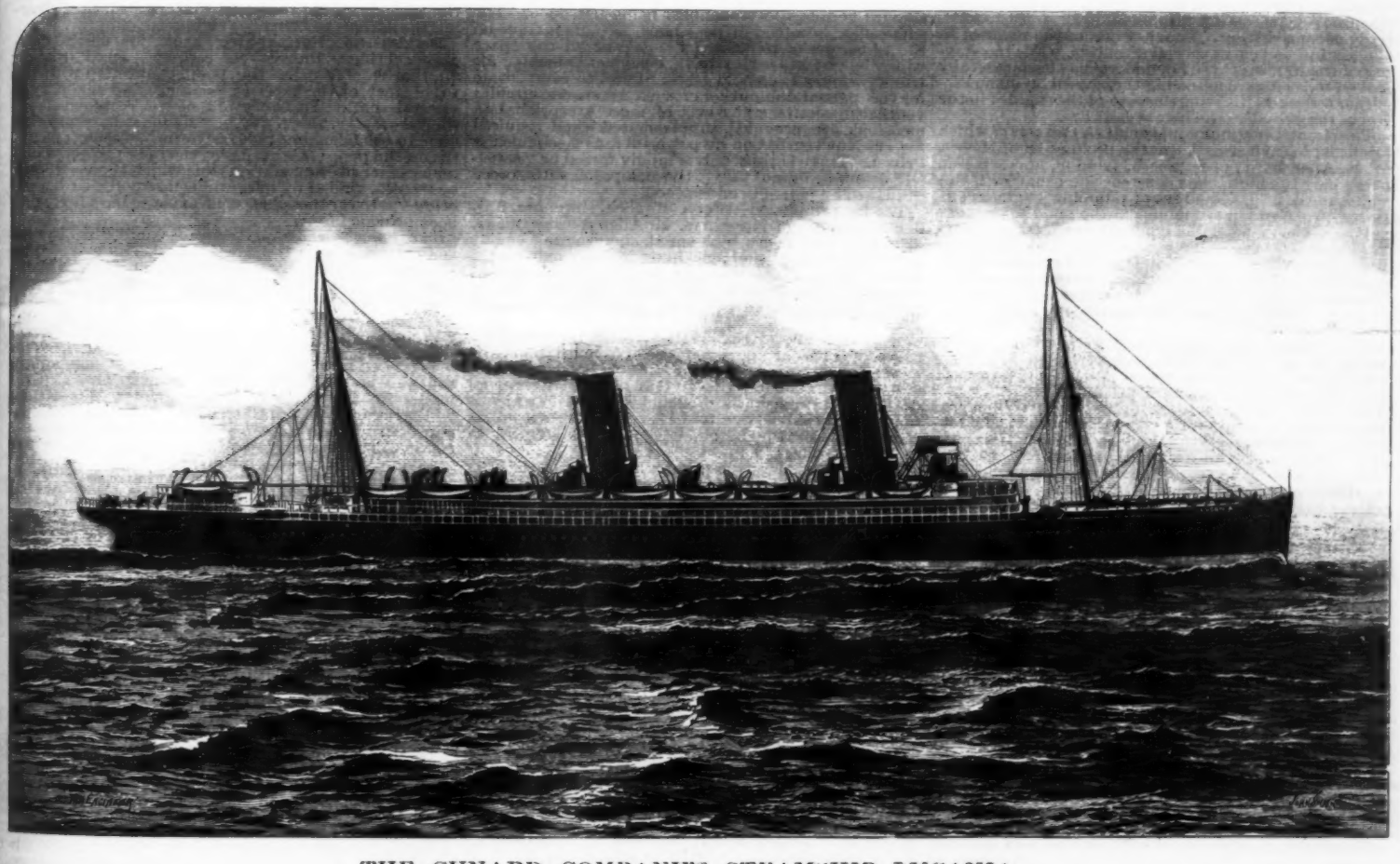
On her westward voyage, completed on the 3d of November, the Lucania maintained throughout an average speed of 21·09 knots per hour, the distance run being 2,780 knots, and passed Sandy Hook Lightship after a passage of 5 days 12 hours 47 minutes. The record was previously held by the City of Paris, which at precisely the same time last year made the passage in 5 days 14 hours 24 minutes, the average speed over the distance run—2,782 knots—being 20·7 knots.

The deduction is a fair one that, when the Lucania is favored with weather and circumstances, she will make the passage at an average rate of about 22 knots in 5 days 6 hours.

One matter in connection with the Lucania—and other large vessels in which vibration is felt—needs to be specially emphasized. It is assumed by many—not by timid passengers only—that the vibratory movements are due to structural weakness. This is quite a mistake, there being quite a radical distinction between vibration and working in a steel ship. Many cases occur where considerable and long-continued vibration on service is associated with no actual working or structural weakness. In numberless instances, too, vibration in ships previously exempt from anything of this nature has been traced to the breaking or loss of propeller blades, while the continuation of voyages under these conditions has not been attended by any working or weakness of the ship's structure.

The chief cause of vibration is undoubtedly the reciprocating movement of the engines, especially when of the vertical type. When the rate of revolution approximates to some multiple natural period of vibration of the structure, vibration attains its maximum values. At intermediate rates of revolutions vibration practically disappears. Thus, in the swift small vessels of the navy having quick running engines, such as in the Sharpshooter class, the revolutions producing vibration are roughly 65, 130, 190, and 260 per minute. Further, in these vessels, it has been established by actual measurement that the greatest vibratory movement—which is actually very small—occurs at quite moderate speeds of the engines when very small powers are being developed, and that at the higher powers the vibration is less. The experience of an eminent naval architect, who lately traveled on board the Campania, and was in a position to learn the facts, is that when running steady at 78 or 78½ revolutions—her normal speed—no exceptional vibration was felt; but when the revolutions were allowed to get down to 75 or thereabout—as, for example, when cleaning fires or changing a watch—vibration was certainly set up. This quite accords with what has been experienced by well informed voyagers on board several of the other crack twin screw vessels engaged in the Atlantic service.

There seems to be no doubt that the whole question of the vibration of high speed steamships must receive greater study in the future.



THE CUNARD COMPANY'S STEAMSHIP LUCANIA.

THE FAIRFIELD SHIPBUILDING AND ENGINEERING COMPANY, GLASGOW, BUILDERS.

The principal dimensions of the Campania and the Lucania need only just be mentioned:

	Ft.	In.
Length over all	622	0
Length between perpendiculars	600	0
Breadth extreme	65	3
Depth from upper deck	41	6
Depth from shade deck	59	6
Displacement, about	13,000 tons.	

The keel of the Lucania consists of a flat plate, 1 in. thick by 54 in. in width, having a doubling plate about ⅞ in. thick on the inside. Above these and coincident with the center line of vessel is a vertical plate 4 ft. 6 in. deep, and above this again is an inner horizontal plate coincident with the inner or water ballast bottom. Double angles connect these together at top and bottom, and the whole forms a thoroughly efficient substitute for the solid or side bar keels, now being discarded in most large ships. In addition to the center-line girder there are four similar built up I girders, two about 15 ft. on either side of the center line, and two close to the bilge, or about 30 ft. on each side of center line, these latter forming the outer margin of the double bottom. In the intermediate spaces between these longitudinal girders are two pairs of intercostals, fitted between the floor plates, and carrying these up to their work. The depth of the center line girder, and of the other girders under the machinery space, is increased to about 8 ft., extra longitudinals being also fitted in this part, to give the necessary strength for the carrying of the engines. The bottom as a whole is on what is known as the "bracket" system of construction, and the bottom frames, instead of being carried from the keel to the top decks, as is usual in ordinary ship construction, stop at the margin longitudinal just alluded to, and are there firmly connected. The side frames extend from the margin plate to the upper deck. The frames, as a rule, throughout the vessel, are of channel section—the size amidships being 8 in. by 4 in. by 4 in.—this special section combining the ordinary angle frame and reverse frame, dispensing with the riveting of the two separate angles together and the setting of reverse frames. The frames are spaced 30 in. apart, and extend in one length from the margin plate of the double bottom to the upper deck stringer plate, and to the poop and forecastle stringers at the ends of the ship. These channel frames are strengthened at intervals fore and aft the ship by solid web frames, or partial bulkheads. These web frames consist of plates, varying from 2 ft. to 3 ft. in width, with double angles on the inside edge, and connected by double angles to each of the deck stringers.

Eighteen transverse bulkheads, of a thickness and with stiffeners scarcely less ample than in the case of the main shell, are provided in the length of the vessel.

The new vessels exemplify in every direction the prominence given by the Cunard Company to the idea of and requisites for safety. From the "crow's nest" lookout, situated on the foremast, 100 ft. above water level—from which a sweep of about fifteen miles all around can be had under favorable weather conditions—down to the long rows of lifeboats flanking the shade deck, there are numberless objects and apparatus, whose presence gives emphatic evidence of the owners' regard for safety. One direction in which this solicitude takes a specially notable form—and one which for essential importance dwarfs all the rest, although not so plainly made evident to the passenger on board—is the thoroughness and minuteness of the subdivision of the hull by water-tight bulkheads.

The greatest distance between any two athwartship bulkheads in the vessels is about 65 ft., or only about

10 ft. for every 100 ft. of the vessel's length. This space comprises the cross bunkers with their connecting tunnels to the boiler rooms, so that even here the unoccupied capacity is not great. These water-tight coal bunkers at the sides and over the top of the boiler compartments are arranged in pursuance of the requirements of the Admiralty for vessels classed as reserve armed cruisers, the casings and their contents forming a partial protection for the machinery against the modern quick-firing gun. Forward and aft of the midship body, and especially forward—where, of course, the risk from collision is greatest—the distance between the bulkheads is considerably reduced. The vessels as a whole, in short, are divided so as not only to conform to the Admiralty requirements for a safe margin of surplus buoyancy with any two compartments open to the sea and flooded, but in several instances even three compartments might be flooded and the vessels remain perfectly buoyant and safe.

Each set of engines has five cylinders—two high pressure, one intermediate and two low pressure. The high pressure cylinders are placed one at each end, above the low pressure cylinders; while the intermediate is in the middle. In this way the great advantage pertaining to the balance of parts and of motion due to the three-crank engine is secured, while the adoption of five cylinders also enables the diameter of the low-pressure cylinders, and the pistons belonging to them, to be reduced to a size giving more satisfaction in working and upkeep. The diameters of the cylinders are: High pressure, each 37 in.; intermediate, 79 in.; and low pressure, each 98 in. The stroke of piston in each case is 60 in. Each pair of low pressure and high pressure cylinders, in tandem position, is connected with the ordinary sleeve stuffing box, having metallic packing. All the cylinders are steam jacketed, and have automatic steam traps for the return of water to the hot well. The high pressure piston rods are not fitted with metallic packing in the ordinary sense, but with long brass sleeves. The cylinders and casings are borne by cast iron A frames supported on a cast iron bedplate of the type which has already proved satisfactory in so many of the splendid vessels produced at Fairfield. The bedplate, which is 5 ft. 6 in. deep, made up of box type castings, is bolted down to an exceedingly strong seating. The bolting of the engines to the seating had extra special attention, while the staying of the top weight of cylinders has been carefully looked to, as regards bracing the several cylinders together fore and aft. From the base of the engines to the top of the cylinders the height is 47 ft.

The circulating pumps and engines, two sets of which are fitted in each vessel, are the production of Messrs. W. H. Allen & Co., of Lambeth, London, and evince in every part the high class construction usual with this well-known firm. Each set of pumping engines comprises two centrifugal pumps in the middle, with one engine on each side. The pumps are Messrs. Allen's "Conqueror" type, having suction and discharge branches 20 in. internal diameter, and impellers 51 in. diameter, and engines of the tandem compound type. The collective quantity of water delivered by each set is about 16,000 gallons per minute, the speed when circulating being 100 revolutions per minute, and when pumping from the bilge 250 revolutions. Circulating pump engines have hitherto, as a rule, been constructed of sufficient power and strength to meet the maximum requirements for pumping the bilge. This entails the provision of a considerably larger engine than is required for the ordinary work of circulation. In the case of the engines under notice, however, the arrangement is such as to effect both kinds of work with the acme of efficiency and economy. By an ingenious arrangement of the steam distribution valves, high pressure steam can be admitted to the low pressure cylinders, so as to give the increased power required for pumping from the bilge. The engines are thus suitable for giving the requisite power for circulating with economical steam consumption, and at the same time capable of exerting the greater power needed for bilging. By this means the size of the engines is considerably reduced. All the working parts of engines are of Siemens-Martin steel, cut out of the solid forgings.

Coming to speak of the shafting by which the power developed in each of the set of twin engines is transmitted to the direct agents of propulsion, the first part calling for notice is of course the crank shaft. This and the whole of the screw shafting throughout were supplied by Messrs. Vickers, Sons & Co., of Sheffield. The crank shaft is 26 in. diameter, built in three similar and interchangeable sections, each weighing 27 tons. Together with the thrust shaft, which is 14 ft. long, the whole crank shaft weighs close upon 110 tons.

The propellers, which are placed in the same line athwartships, each consist of three blades of manganese bronze, cast in the Fairfield shops, and a boss of Vickers steel of the same quality as the shafting. Each blade weighs about eight tons, and the total cost of this individual—small but essential—item amounted to something over £3,500.

The arrangement adopted with regard to housing the propeller shaft within the vessel's shell is a protection from corrosion and breakdown; but with the view of directly preventing racing and safeguarding the shafting and main engines against any such occurrence as proved so disastrous in the case of the City of Paris some two years ago, governors of an efficient type have been fitted. In addition to one of Dunlop's governors which is fitted in connection with the propeller shaft, and to the ordinary governors fitted to the main engines, a still more notable safeguard is provided in connection with the starting and reversing gear fitted by Messrs. Brown Brothers, of Edinburgh. This latter is the "emergency governor" gear, which Mr. Brown was led to scheme out and perfect as a means of guarding against any repetition of the accident above alluded to. By its means the engines are stopped automatically if any rate of speed—before determined and arranged for—be exceeded. The City of Paris, after being re-engined, was fitted with this emergency gear; and after severe tests, in which it acted unfailingly, the New York also was fitted.

Steam for the supply of all the numerous engines is obtained from twelve great double-ended boilers, 18 ft. diameter, 17 ft. long, each having eight furnaces of Fox's corrugated type, four at each end. One combustion chamber is common to each pair of furnaces.

In addition to the main boilers there are two others for auxiliary purposes—one 18 ft. diameter by 11 ft. long, having four furnaces, which supplies the subsidiary and deck machinery, and one 10 ft. diameter and 10 ft. long, which provides steam for donkey engine purposes when the vessel is in port. The whole of the boilers may be used in the actual propulsion of the vessel if thought necessary, the total number of furnaces available being thus 102. The main boilers are worked at a pressure of 165 lb., and are the largest hitherto constructed for that pressure. The plates used in the construction of the Lucania's boilers were supplied by the Parkhead Steel and Forge Company, while those for the Campania's were furnished by the Steel Company of Scotland. Some of the plates worked into these boilers measured as much as 20 ft. in length by 7 ft. in width, the thickness being $1\frac{1}{16}$ in.

The boilers are placed for fore-and-aft firing, three in a row athwartship, and in two separate groups, being in a self-contained compartment with a large athwartship coal bunker between. Coal bunkers are also provided at each end of the boiler rooms and over the boilers at the sides, the coal being passed on to the stoking floor by shoots at the side, fed from the main coal bunker between the boiler compartments.

Each of the main boilers is fitted with 950 to 1,000 tubes in lengths of 6 ft. 9 in., or roughly, has one mile and a quarter of tubing. The tubing in the whole installation of boilers in each ship, if laid together end on, would reach a distance of fifteen miles. There is a funnel for each of the two self-contained groups of boilers, the distance between which is as much as 130 ft., owing to the large space occupied as boiler rooms, and to the presence of the intermediate cross bunker, which occupies the full width of the ship, and for 65 ft. of its length. The great height—130 ft. from keel to top—and large diameter—19 ft. inside casing—of these funnels are noticeable features already commented on in former issues, and sufficiently evident from the view given on first page.

Forced draught—as this is generally understood—does not enter into the list of agencies by which the Fairfield Company has attained its success with the great Cunard vessels, the stokeholds being left open. The exigencies, however, of passenger accommodation on the upper decks prevented the use of all the space which might otherwise have been available for air trunks or open stokehold gratings, and to compensate for the partial diminution of such air spaces, circular ventilating shafts and cowls of most exceptional dimensions are provided, supplemented when required for efficient ventilation by powerful fans mechanically driven. There is thus only a mildly forced or "assisted" draught, in no way to be compared with forced draught as commonly understood.

The fans employed—twelve in each ship—are 8 ft. 6 in. diameter, of Messrs. W. H. Allen & Co.'s make, driven by that firm's high-speed, single-acting engine of the triple-expansion principle with only one crank. These engines are specially suited for continuous working at high speed without attention. The moving parts work in a bath of oil, and, being inclosed, are effectually protected from any dirt or coal dust. Eight of the fans are of the single-breasted type, and employed for the ordinary purposes of ventilation; the remaining four are of the double-breasted type, and are available for the system of assisted natural draught obtaining in the stokeholds, a system which is found in actual service to be most advantageous as regards comfort for the stokers, and quite efficient as an aid to combustion.

From early times, when water simply as taken from the sea was employed for steam raising purposes, till the present day, when every care is exercised, and every device known to the wit of man employed, to prepare the water for such purposes, the advance is considerable. At the present day, economy and efficiency to their uttermost fraction seem to be studied, and quite a host of auxiliary machines—feed heaters, filters, evaporators, etc.—have been called into existence.

The feed-water heater is suitable for 30,000 indicated horse power. The heating steam is taken from the intermediate casing of the main engine, and from the exhaust of the auxiliary engines, and led into the heater through a non-return valve on the side of the apparatus. A circular ring and conical spray piece with perforations are fitted, to mix the water and steam uniformly.

Another of the specialties supplied by this firm are the evaporators, of which four have been fitted to each vessel. Each of these has a productive capacity of 30 tons of fresh water per day. The special arrangement of the tubes gives these evaporators a very high rate of efficiency, and the results of those fitted to the Campania show that it is only necessary to work them for a few hours each day in order to keep the boilers fully supplied with feed make-up.

The feed water before passing into the boilers is subject to yet another preparatory process, which, as it is a comparatively new feature in the machinery department of steamships and has a direct bearing on the efficiency and the durability of the boilers and furnaces, may be treated of with some detail. This is the purification of the feed water from greasy matter, grit or metallic oxides, incidental to its contact with the copper feed pipes, condenser tubes and with the oily particles from the engine cylinders, etc. So recently as two or three years ago, marine engineers were still concerned to find that despite every care, the furnace crowns of boilers would occasionally collapse, and the combustion chambers buckle and otherwise get out of shape, entailing much expense and inconvenience. These troubles were attributed to various causes, but the exceedingly simple but careful experiments made and communicated by Professor Lewis, of Greenwich, two years ago, went far to show that the principal cause was the deposit of grease on the heated surfaces of the boilers, particularly the furnaces and combustion chambers. It was found by him that an oily deposit of only one-sixteenth of an inch in thickness on a boiler plate subject to a pressure of 80 lb. would speedily be heated to a temperature at which it would be totally unable to withstand this pressure, and collapse would inevitably follow. In addition to this, Professor Lewis demonstrated that the same coating of one-sixteenth of an inch retarded the heating properties of the fuel by one-half, cold water in a clean vessel being raised to boiling point in ten minutes, whereas in a vessel with an oily coating of one-sixteenth, it took fifteen minutes to reach the boiling point. Mr. Parker, chief engineer surveyor at Lloyd's at the time, had already arrived at a similar conclusion some years before. These considerations turned the attention of engineers to the purification of the feed water from oily matter, and several engineering inventors were successful in devising simple and compact apparatus to effect this important end. The purification of the feed water of the Lucania and of the Campania is effected by a specially designed "Harris" compound feed-water filter, supplied by Messrs. Copley, Turner & Co., of Middlesborough. The filter and connections form the most complete, and by a good deal the largest, installation for feed filtration that has yet been designed. It has to treat not only the condensed steam from the main engines, but also from the numerous auxiliary engines and pumps, all of which contribute their quota of grease and impurity. The total amount of water dealt with exceeds 5,000 tons per day, or 60,000 tons for the run from Liverpool to New York and back again; the entire contents of the boilers being converted into steam, and passing through the engines and condensers and feed-water filter five times each twenty-four hours.

Both telemotor and pipes are full of water mixed with glycerine to obviate the chance of freezing. By moving the small steering wheel in the wheel house in either direction similar motion is imparted to the piston of the telemotor aft, which in turn moves the steam steering valve, and the tiller follows. This movement also compresses in either direction a pair of spiral springs—just over the main steering engine—so that the more helm the quartermaster on the bridge gives, the harder he finds the wheel to move, by reason of the increased resistance offered by the springs. When the wheel is pulled hard over, and it is necessary to steady the ship, it is only necessary to "let go," and the springs will cause the whole gear to travel to midship line. These springs perform another important function, viz., any tendency of the telemotor indicator to get out of correspondence with its cylinder aft is corrected by a communication being opened between both ends of the cylinder every time the wheel is moved from port to starboard, thus allowing the springs to bring the rudder to mid-gear.

Besides the principal steering station on the navigating bridge, the vessels can be steered from an alternative station on the poop, connection with the valve gear of the steering engine being made by a vertical shaft. In the event of the employment of the vessels as cruisers, and any damage by shot being done to the telemotor pipes or to the steering apparatus on the poop, there remains the fully protected and underwater steering station from which the vessels can be steered, guided by telegraphic instructions from the bridge. Every possible contingency has, therefore, been provided for.

The telemotor arrangement of controlling the aft main steering gear, it may be added, was invented by Mr. Brown some years before the steam tiller, as above described, and has been fitted in connection with the patentee's system of hydraulic power steering gear on board a large number of steamers. It makes, however, an equally efficient conjunction with the steam tiller gear, and steering installations of this type are being fitted into numerous large vessels, among others the two large American line steamers nearing completion in the yards of Messrs. Denny, Dumbarton, and Messrs. Thomson, Clydebank. The American legation in London also have at present under consideration the advisability of fitting the gear to the war ships now building at Philadelphia.

The windlass and gear in connection were made by Messrs. Napier Brothers, Limited, Hyde Park Street, Glasgow, and is of the same type as supplied by them to the British government for H.M.S. Hood and Crescent, but more powerful, as the cable in the Hood—the very largest of the battle ships recently constructed—is $2\frac{1}{16}$ in. in diameter, whereas the cables for the Cunard vessels are 3 in. diameter. The heavy nature of the work which cables and windlass alike have to perform may be thus appreciated, but it may be explained that the anchors are the heaviest bar anchors yet manufactured—of ten tons weight. They are of the Trotman type, and, together with the cables, were supplied by Messrs. Wood, of Saltney, Cheshire.

The engines, as well as all the mechanism connected with the driving of the cable wheels or drums, are placed between decks.

Of the state-room accommodation proper it is difficult to give a correct idea. There are rooms to suit all tastes among first and second passengers. A large number of single-berth cabins is provided, and many double cabins, together with three or four berth rooms, while family apartments are not lacking, in addition to magnificently appointed suits. Doors at the fore end of the drawing room and of the dining saloon lead into passages, along which are ranged the state rooms *par excellence*. Many of these have large, open sitting rooms attached, finely fitted in polished hard woods, and beautifully furnished. Most of the first-class state-rooms are ranged along the sides, but a proportion of them is in the center.

The second-class accommodation, which is on a scale of comfort scarcely less complete than the first class, is all placed abaft the machinery on all three decks. The dining saloon is on the upper deck, and is finished in a style equal to that of the principal saloon in ordinary ships, in solid oak, and fitted with tables, revolving chairs, sideboard, etc. This, together with a separate room for children and servants of the second class, enables the second-class passengers to dine in two groups. The drawing room is on the promenade deck, at the head of the stairway leading to the dining saloon and state-rooms. The smoking room is on the poop, with a stair leading from the cabins below, and is finished in American walnut.

The steerage passengers—of whom from 700 to 1,000 may be carried—are accommodated on the lower deck, iron portable berths having been provided by Messrs. Hoskins & Sons. These passengers will be allowed to promenade on the upper deck, the circuit of which four times, as we have already stated, makes a one-mile walk.

The commissariat and kitchen arrangements for the immense numbers housed on board the Lucania—which on occasions may number close on 2,000 souls—are, as may readily be supposed, of the most complete

and efficient description. Large pantries, one on each side of the steamer, are fitted up on the main deck, contiguous to the main entrances to the dining saloon. These are equipped with steam hot-plate tables, tea and coffee making apparatus, and all such like requisites of the standard pattern for this class of ship. The galleys, scullieries, and bakeries are arranged *en suite* on the port side of the vessel on the lower deck, access being obtained by a stair from the port side pantry. Hoists are provided for the expeditious transit of dishes, etc., two and from pantries and saloon. The galley is not the confined apartment common to most ships, but is really a large, well lighted, and carefully ventilated kitchen, 25 ft. or 30 ft. square. Along one side are tables with all kitchen utensils and chopping boards, while the other is completely taken up with a range 25 ft. long by 4 ft. wide, upon which nearly 170 ordinary stew pots or pans might be set. Special boilers are utilized for various purposes, such as vegetable cooking, etc. For this purpose steam is employed, which circulates round the outer casing of the boiler. There is also an immense grill, and here, as in the case of the range, the waste heat is utilized for heating plates, etc., in small ovens in the uptake. The arrangements described are those in connection with the creature needs of first and second class passengers, the kitchens and scullieries for steerage passengers and crew being on a similarly large scale, and situated under the forecastle.

Extensive cold air provision stores have been provided below the kitchen on the orlop deck. The cold-air chambers are worked on the De la Vergne ammonia compression principle, the installation of machinery and fittings being by Messrs. L. Sterne & Co., Glasgow. This and the still more elaborate refrigerating machinery and chambers on the same deck for cold storage of meat cargo —which plant was supplied and fitted by the Kilbourn Patent Refrigerating Company, of Liverpool—forms too large a subject to be treated of in the present issue.

The lavatory accommodation provided is in every way commensurate with the needs of a huge floating hotel, otherwise so lavishly appointed. We need not here be any more precise as to the location and equipment of these quarters, further than to say that they are conveniently located for all classes, and fitted on the most modern scientific principles.

The lighting of the Cunard vessels by electricity has been carried out by Messrs. Siemens Brothers & Co., Limited, London. The generating plant is in duplicate, so that in no case can there be any collapse, two sets being placed on each side of the center line bulkhead dividing the engine room. There are in each ship about 1,350 lights, and these require an output on the part of the dynamos of 42,000 watts. The current is distributed throughout the ship by about fifty miles of wire, thickly insulated in vulcanized India rubber, and laid on the return conductor system in connection with Siemens patent distributing boxes. The electric current is generated in each ship by four H. B. dynamos, $\frac{1}{10}$ type, each driven by a separate engine, all four being similar. The cylinders are 9½ in. and 15 in. diameter, with a stroke of 10 in. Any two are equal to running the 1,350 16-candle power lamps in the ship, including the large reflectors of eight lights each for working the cargo, together with the search light for facilitating the navigation of the ship into port—picking up the moorings—and for scout purposes should the vessel be engaged as an armed cruiser. The engines for driving the dynamos are of the open, vertical, compound "Crescent" type, manufactured by Messrs. G. E. Belliss & Co., Birmingham.

A search light is also provided, and its arc lamp works with a current of fifty amperes, the difference between the standard pressure of ninety-five volts and that required for the lamp being absorbed by means of resistance coils.

As regards heating, the whole of the passenger accommodation throughout the vessel, including the main apartments where passengers "most do congregate," is provided with a thoroughly efficient system of steam heating, all so arranged by branches and stop cocks that the whole or any part may be heated when, and to the appropriate temperature, required.

THE STEERING OF SCREW PROPELLED VESSELS.

To the Editor of the Scientific American:

Before writing to you on this subject I have awaited the termination of the court martial at Malta as to the loss of the Victoria.

More than thirty years ago (being at that time an engineer), I publicly called attention to the effects of various *managements of power* in steering screw propelled vessels, and was owned to being correct in my deductions by one of the most eminent engineers of that time, who was then carrying out steering and other experiments under Admiralty inspection.

In theory, it may, perhaps, be supposed that screw propelled vessels (as floating bodies) when steering turn on their center of gravity. In practice they do not. Please, sir, also to bear in mind the facts that wherever there is friction there is more or less adhesion; and wherever there is adhesion between any part of a moving vessel and another substance, even though that be water, then either the point where such adhesion takes place or else a point between the point of such adhesion and the point of the vessel's center of gravity becomes the point upon which the vessel will turn when being steered. Thus circumstances invariably cause vessels to turn on some other point in their length than their center of gravity. The effect of the force used for steering any vessel will have its effective power in proportion to the leverage its direction will give it over the center point of turning, which the circumstances of adhesion of wind, water, etc., may have produced. If the propelling screw or screws of a vessel as they revolve at the stern had no hold on the water, they could not propel; but having really (by their speed in turning) a very considerable hold on the water, they thus prevent the lateral movement of the stern, causing the center point of turning (so long as the screw or screws are kept at work) to be considerably abaft the vessel's center of gravity, and, of course at the same time giving any force produced by wind or water on her head and fore part very considerably more power *to resist the power being used for steering.*

Leaving out the subject of sails.

In any screw propelled vessel *having speed on her*, should it be required to turn her sharply (as in the case of H. M. S.S. Victoria) her engines should be stopped for the time being, her rudder only being used; she would then turn on a point corresponding with her center of gravity, or upon one considerably nearer her bows, owing to the adhesion from friction of the water on her bows which her speed was producing.

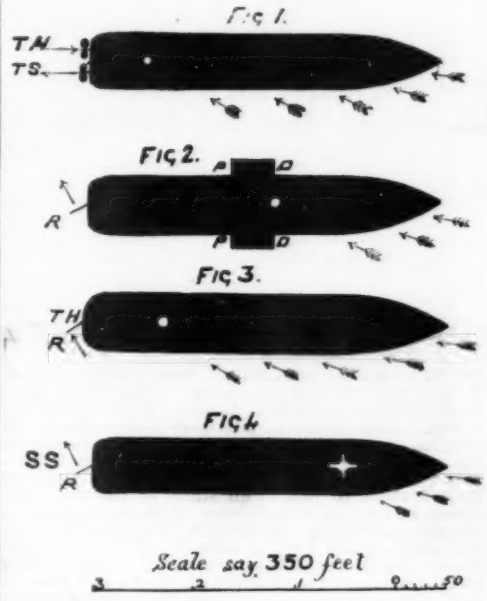
Her rudder having thus considerable leverage upon her center point of turning, she would turn quicker and in very much less space than when her screw or screws are kept at work during the evolution.

Many a vessel that has been stranded upon a lee shore could have been saved by thus attending to the mechanical laws of force and of adhesion which takes place through the friction between the water and her screw propeller owing to its rapid revolution.

In all the evidence at the court martial that I have had the opportunity of reading, I did not notice any consideration as to the direction of the wind. The harder their engines worked, the more effect would wind and wave have had for or against their turning.

Many of our vessels are not ships at all. They are machines afloat, and it would be unreasonable to expect a sailor to know their management unless he also become an engineer.

Finally, do not mistake me, sir, and consider that I am saying one word against twin screw propulsion, or in this letter either one word as advocating or running down this or that invention. I merely here write to once more, after an interval of more than thirty years, again call attention to the engineering and mechanical forces affecting the steering of vessels, *when speed is on them*, and which forces are now, at the present moment (at will) under the command of the officers. Further, the correctness of this theory is easily proved—there are plenty of screw launches, tugs and other vessels afloat. This experiment in steering entails no special preparation and no additional expense.



To make this important matter *quickly clear to yourself, sir,* I here inclose you four sketches with a short description of each:

Reference.—The white spot shows the point in the vessel's length upon which she turns; T H, screw turning ahead; T S, screw turning astern; →, direction of power steering; ⇒, direction of principal natural forces retarding steering; P D, paddle wheel; R, rudder; the white cross shows the point upon which the vessel will turn; S S, screw or screws stopped turning.

Fig. 1.—A vessel propelled and steered by twin screws and rudder. The direction of the force of each screw has here about ten feet leverage on the center point of turning, the force acting on her rudder a leverage of some forty feet, while the forces of wind, wave and water may have a leverage of from naught to three hundred feet along her length, acting against her steering or turning.

Fig. 2.—A paddle wheel steamer.—Owing to the hold of her paddles to the water (when revolving) her center point of turning will be near her center. Hence the effect of the force of wind or water along her length would be about equal for and against steering, while the direction of the force exerted by her rudder would have a leverage for turning her of at least nearly half her entire length.

Fig. 3.—A vessel propelled by the revolutions of a single screw, the adhesion of which to the water would cause her center point of turning to be near her stern. Hence the direction of the force exerted by her rudder would have but a short leverage, and the power thus used be of but small value as a steering power, while that power exerted by wind, wave or water along the greater portion of her length would have by leverage considerable power to retard her turning.

Fig. 4.—Represents a screw steamer with her screw or screws stopped in order to turn her sharply *while speed is yet* on her. Her center point of turning would (as explained in my letter) be near her bows. The force exerted on her rudder would thus have a leverage of between two to three hundred feet, while the various forces exerted on her bows against her answering her helm could have but a leverage of a few feet. Hence her stern would swing round on her bows and thus turn her in a very short space of time and distance, simply because her screw or screw propellers have (for the time being) ceased to have a hold on the water at her stern.

ROSE.

ROADS OF ITALY AND SPAIN.

GENOA boasted of fine roads long before Columbus was born. The streets to-day have a bed of sand nearly six inches deep, upon which are laid stones about two and a quarter feet long, one foot wide, and nearly eight inches thick. The face of the stone has to be grooved to afford a foothold for horses. The sidewalks are constructed in the same way, but with a thinner bed of sand and thinner stones. The steep streets, of which Genoa has many, have smaller stones, and between each two rows of them is placed a course of bricks set on edge, to give horses a surer foothold. Genoa has fully a thousand streets too narrow for carts or carriages, and these are constructed of round or oblong flint stones, with a central pathway of brick in the steepest of them to give a better footing for pedestrians. There are also macadamized streets in Genoa, and recently, as Consul Fletcher says, experiments have been made with small round blocks of oak in a sand bed. On the whole, we have nothing to learn from Genoese streets.

In Lombardy, according to Consul Pepper, the condition of the roads of all descriptions is far superior to that of any other part of Italy.

The scale of wages in Italy given by Consul Jones includes 60 cents a day for a stonecutter, 40 for a laborer, 24 for a boy, 20 for a woman, $1.20 for a horse, cart, and driver, 30 cents for a pack donkey and driver, and 1 cent for the hire of a wheelbarrow.

In Bologna the prevailing method of street making, according to Mr. Gardini, is to lay flint stones on a band of sand or of sifted gravel, while in some streets on each side are placed bands of granite. In Florence hard stone of excellent quality is used for paving, being set in lime and having its surface fluted. The country roads in Tuscany are paved with broken stone.

Sicily naturally has, as might be expected, little or nothing to teach us in the way of road making. It is, as Consul Pugh remarks, so distinctively an island of rock as to make any other material for streets and roads out of the question. The abundance of limestone and the cheapness of the labor in preparing allow the principal streets of cities to be paved with solid blocks of it, from 18 in. to 2 ft. square and 8 to 10 in. thick, laid in mortar and placed on a bed of concrete. This durable paving costs not over $3 per square yard.

In Messina the pavements are of paving stones, cobblestones, pebbles, and a union of the first two. Sometimes paving stones are placed on a bed of mortar, and sometimes a layer of cement and small pebbles is put under the mortar and paving stones.

The streets in Catania, in Sicily, are very good. The foundation is broken lava, in pieces of 2½ in. or less diameter, firmly cemented together with burnt clay and lime to a depth of about 8 in. Then comes a superstructure. The pavement in the best streets is of what is called No. 1 hard lava, quarried very rough in blocks about 16 by 20 by 8 in. and worked in the street itself. The blocks are laid in cement and the edges are fitted with great nicety. Driving on such a street is most comfortable, with its smooth surface and absence of jolting, and the streets are even preferred for ease of driving to the country roads. In three respects, therefore, Consul Heath finds them worthy of imitation here, namely, the size of the paving blocks, the smooth surface with lack of open joints, and the foundation of cement and stone. On the other hand, the country roads of Catania are generally poor, being made of an inferior quality of lava, with lumps of clay thrown on top: and their main merit is their cheapness of construction. The action of wheels mixes the clay and lava into passable condition.

Turning now to Spain, we find the wheelmen, who are the great popular authorities on the condition and needs of roads the world over, declaring that in northern Spain the roads are fairly good and in southern Spain execrable. The president of one of the three bicycle clubs of Barcelona assured Consul Bowen that Spanish roads were vastly inferior to those of France or England, but that he hoped, now that Spain has a bicycle branch in its post office department, that her roads would be made equal to any in the world.

The most ancient Roman road outside of Italy is said to have been in Spain, where it was constructed for military purposes; but, according to St. Isidoro, both the Carthaginians and Phenicians opened roads there before the Romans. Be this as it may, the latter constructed a fine system of highways by excavating roadbeds, then placing on them a layer of stones, sometimes in mortar, over it a stratum of cement or plaster, then another of sand and lime or clay, and then a top of stones united with cement. The roadway was curved from the middle toward the strongly made curbs, which at regular distances were elevated to serve as styles for the mounting and dismounting of horses. They were supplied with distance posts, and along the principal routes were stations, called *mansiones*, about thirty miles apart, each of which was kept supplied with forty horses and carts, and with oxen and pack mules for transportation. In Spain alone there were thirty-four imperial highways, aggregating 6,926 miles, while one authority makes the total mileage, including commercial routes, 20,000 miles. The ancient names of these *mansiones*, as noted most carefully by Caracalla to the number of hundreds, are very interesting to compare with the modern names of the same sites. Thus Osca becomes Huesca; Cæsar Augusta becomes Zaragoza; Calagurra becomes Calahoara; Sebelaci becomes Bechi; Castulone becomes Cazlona; Malaca is Malaga; Gades is Cadiz; Regiana is Regna; Emerita is Merida; Olisipone is Lisboa; Suissatio is Zuazo, and so with scores of others.

Just sixty years ago a bureau of roads, highways, and canals was established in Spain, and many laws upon the subject have been made; but Consul Turner points out that there is a conflict between local and centralized power which is unfavorable to the work, and that the slowness with which the labor is performed must make the work expensive, in spite of the low wages. For instance, grading and leveling are done with materials that are carried to their position in small baskets balanced on the heads of laborers, who walk

along leisurely. In extensive works a slow-going donkey is substituted for the man with the basket, and is equipped with large saddle bags loaded with the material. The streets of the cities are named by city councils often in honor of men, and the names are therefore apt to change with the governments.

Barcelona consists of two parts, the old city and the new, or *ensanche*. In the former most streets are paved with stone, and very few with asphalt, cylindrical pegs, or flags. There were some wooden pavements, however, consisting of blocks of red pine from northern Europe or of Swedish fir, on a plaster foundation. Consul Bowen gives this account of some new pavements, with which experiments are being made:

"One kind is an artificial cement pavement, which consists of a hydraulic plaster from 10 to 12 centimeters thick, on which is laid a cover of Portland cement from 4 to 5 centimeters deep, mixed with coarse sand, and then rigidly rolled and compressed. The durability of this pavement is said to be great, and it is well adapted for the use of carriages and bicycles. Another kind consists of pegs that are made from the branches or trunks of the oak tree and that are 10 centimeters long and from 3 to 6 centimeters in diameter. These pegs are laid vertically over a layer of stone broken in pieces from 4 to 5 centimeters in size, and rigidly rolled and compressed, and covered with a coating of coarse sand from 5 to 6 centimeters thick. The spaces between the pegs are filled with sand. The cost of this kind of pavement is about 11 pesetas the surface meter.

"In the new city, or 'ensanche,' the streets are of great length and of a width that is never less than 20 meters and that attains sometimes 30, 50, and even 60 meters. In fact they compare favorably with the very finest streets in the world. The pavements laid there are, for reasons of economy, made from stone brought from the neighboring quarries of Montjuich."

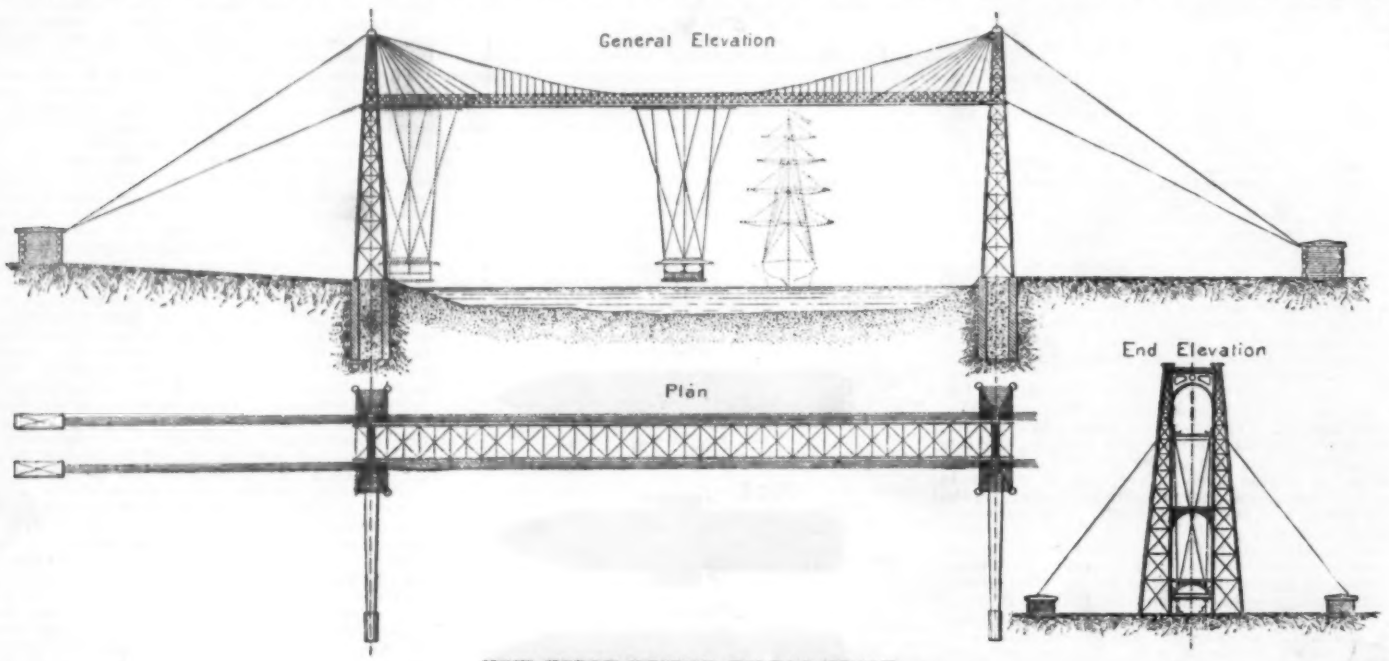
The streets of Madrid show well-cut stone blocks, laid in sand. Those of Carthagena, however, have badly cut stones, according to Consul Molina, of an exaggerated wedge form, with the bottom much reduced, so that they are laid in mortar. However, Belgian blocks, limestone blocks, and those of smelted slag are also of late in use. Altogether there is nothing to be learned there on this subject. As for Denia, its streets are of mud, repaired by "occasionally dumping into them," says Consul Malmzos, "some cartloads of rocks of all sizes, from that of a human head to that of a walnut." Yet there are good macadamized country roads in the district adjoining.

One street in Malaga is reported to have the Nicholson pavement, while others are macadamized or paved with syenitic blocks. Valencia has pavements of hewn stone. One of its interesting experiments, noted by Mr. Mertens, is that of a cart track of steel flat-top rails, which gave such excellent results that a double track was to be laid the whole way to the port, for heavily laden carts. The distance between the two iron tracks is about 1¼ yards, and a steel crossbar holds them at the right distance, the roadway between being paved. One side is used as an up route and the other for going down. The cost, though the steel rails are imported, is only about $10 per running yard, put down and ready for use.—*N. Y. Sun.*

NEW FERRY BRIDGE AND OTHER ENGINEERING WORKS AT BILBAO, SPAIN.

THE somewhat peculiar type of bridge construction illustrated herewith has been erected at the mouth of the river Nervion, on the coast of the Bay of Biscay, not far from the city of Bilbao, Spain, for the purpose of enabling traffic to pass across a large water span, from Portugalete to Las Arenas. It is claimed that this particular system of transport is exceedingly well adapted for all such situations as are represented in the general elevation, where it is necessary to cross broad waterways, and leave sufficient headway for tall masted ships to pass at all states of the tide. The structure consists of a skeleton platform, as shown in the plan, carried by a suspension bridge, resting upon iron piers. Rails are laid on both the up and down stream side of the platform, upon which runs a frame on friction wheels, from which the ferry car is slung by iron cables or wire ropes. The motive power employed may be of any description, from ordinary hand hauling to the most improved method of electric traction, depending upon what description of traffic the car is used for, whether for foot passengers only or, in addition, for animals, goods, carriages, or even railway vehicles. While, therefore, fulfilling all the duties of an aerial ferry boat, the car is free from the disturbing influences which frequently dangerously affect the boat, such as currents, waves, collisions, and fogs. As the car, moreover, is at a fixed height, adjusted to that of the landing place, it is not affected by the rise and fall of the tide, and can pursue its regular seesaw course equally well by night as by day. The car is suspended from the movable frame by triangulated bracing, in such a manner as to obviate any effects of oscillation which might be produced by the action of the wind.

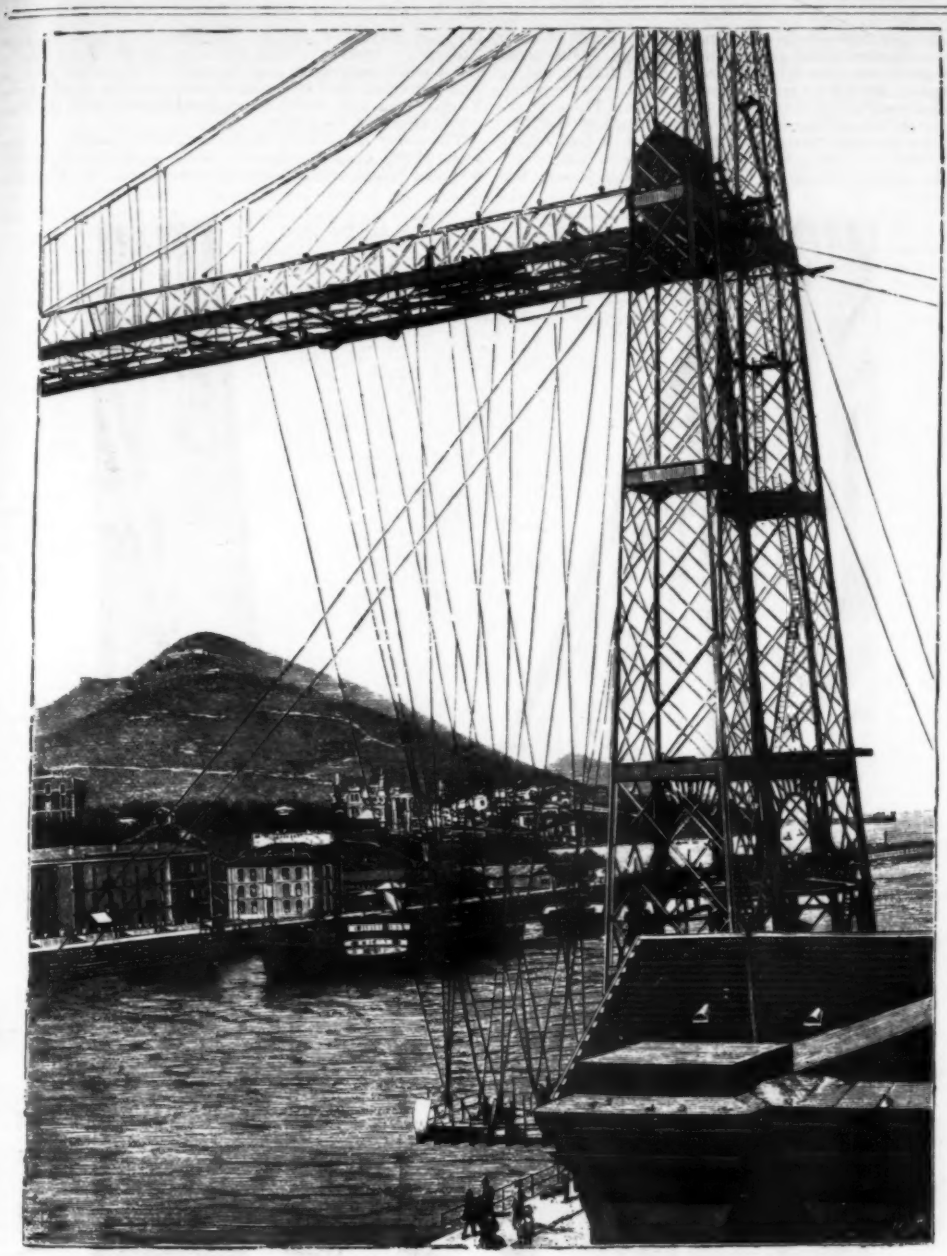
Le Genie Civil, so says *The Engineer*, institutes a comparison in point of economy between this novel method of transport and that afforded by high level bridges with long and expensive approaches, on gradients sufficiently steep to militate severely against traffic of all kinds. The example selected is that before us, which has a span of 530 feet and a headway of 128 feet. With a gradient of 1 in 20, which is 20 per cent. steeper than the rules of the Board of Trade allow for turnpike roads, each of the approaches would be half a mile in length. We may, perhaps, point out here that the use of lifts would render heavy approaches unnecessary. It is contended that swing, draw and telescopic bridges do not offer the same advantages for large spans as the ferry bridge, as they are not only of a very heavy type of construction, but are also not adapted for any but comparatively small spans. In addition, they contract and obstruct, to the detriment of navigation, the very waterway they cross, and require costly mechanical appliances to set them in motion. On the other hand, the ferry car leaves the waterway intact, and crosses only between the passage of vessels as a foot passenger crosses a street. Should any unforeseen obstacle suddenly intervene while the car was *in transitu*, its motion can be promptly reversed, so as to avoid fouling the impediment. Whatever might be the nature of the motive power to be employed, or the description of bridge, no flooring or roadway is needed. The principal members of the structure are all that are required, and if properly braced together, they would not be very numerous. A small footpath on each side would allow of the passage of the person charged with the supervision and lubrication of the rolling apparatus. Judging from the results attending the working of the first ferry bridge at the mouth of the river at Bilbao, the experiment has proved perfectly successful. With 150 persons in the car, the transit over a span of upward of 500 feet is accomplished in one minute, and the time might be easily reduced to forty-five seconds. It is stated that the public highly appreciate the convenience, the smoothness, and the rapidity of this system of locomotion. When fully loaded, the total weight o[f



NEW FERRY BRIDGE, BILBAO, SPAIN.

D. M. ALBERTO DE PALACIO.

COLOSSAL BRIDGE AND BUILDING DESIGNED BY PALACIO, BILBAO, SPAIN.



THE PALACIO MOVING BRIDGE RECENTLY INAUGURATED AT BILBAO, SPAIN.

the car and the rolling gear amounts to 40 tons, and does not produce in the suspended platform of the Bilbao bridge as much appreciable deformation as light vehicles caused to the old type of similar constructions.

In addition to our diagrammatic elevation, we give perspectives of this bridge from *La Ilustracion Española*, in which it is stated the design of the work is due to Alberto Palacio, a distinguished Spanish engineer. We give his portrait, also sketches of two other engineering works, for all of which we are indebted to *La Ilustracion Española*.

One of our additional sketches shows the rolling bridge for crossing the Nervion River, Bilbao, at the point called El Desierto. On each side of the river a pier is built on iron posts, and between the two piers, laid on the bed of the river, is a railway track, which is traversed by means of a steam platform car, on which are cabins for passengers and space for horses and carriages. The trucks of the car are under water. The wheels of the car are worked by steam power carried on the platform. This method offers no obstruction to the river. The work is the design of Engineer Palacio.

Another great work in Bilbao by the same engineer is a colossal bridge and municipal building in the center of the city, of which we give two illustrations. This part of the town, which heretofore has been a waste and foul place, is by these noble structures rendered highly attractive and important.

The bridge, on which the noble building is erected, has a width of about 700 feet. The building has a central covered passageway as shown in one of our engravings, and here the merchants of Bilbao may meet for the transaction of business, independent of any inclemency of the weather.

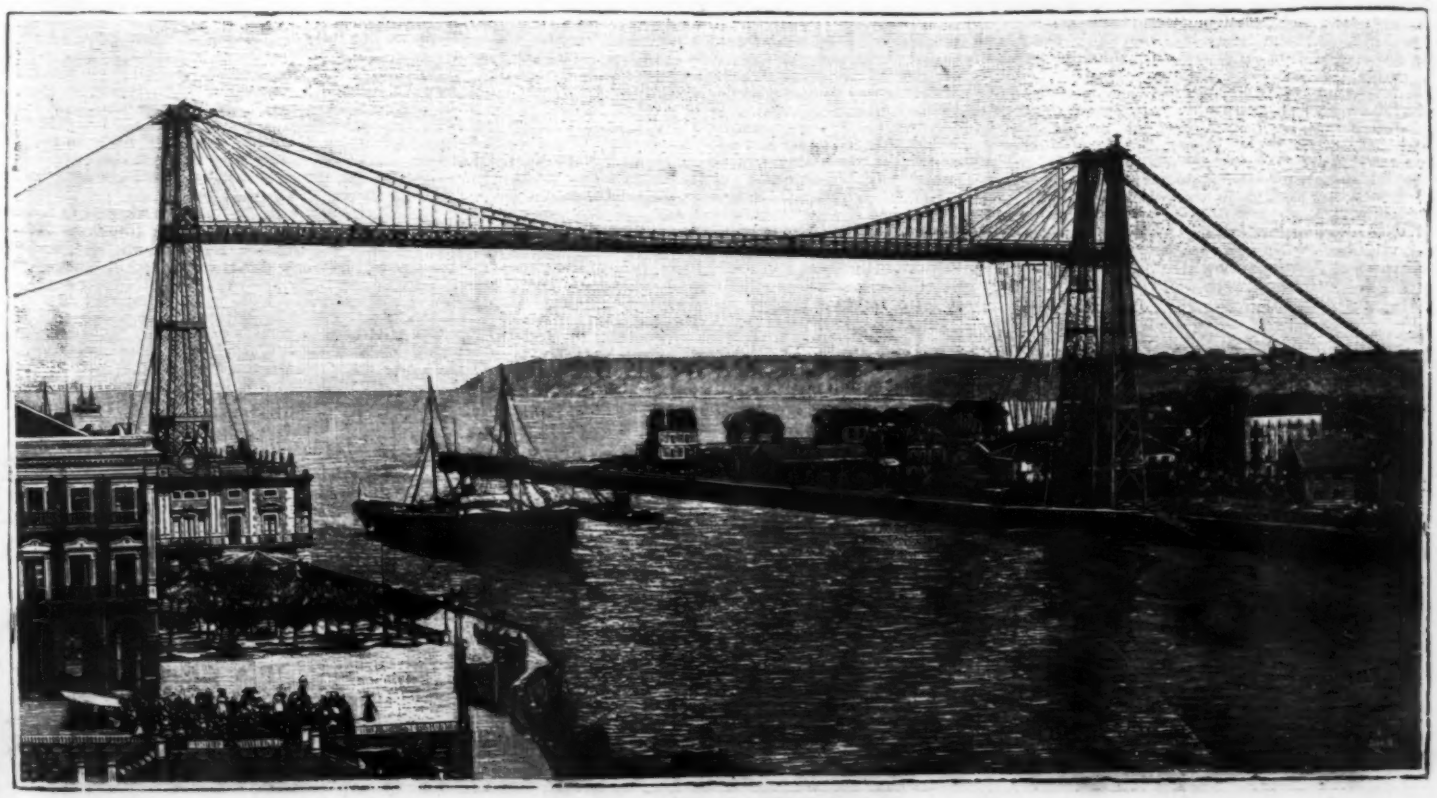
Don Alberto Palacio, architect and engineer, although still a young man, is the author of several other notable works. He completed his education in science and architecture in Madrid in 1882, and subsequently studied in Paris. The remarkable design for a Columbian monument, in the form of a great sphere, which was published some time ago in our SUPPLEMENT, was the design of Mr. Palacio.

THE VISIT OF THE FRENCH ENGINEERS TO AMERICA.

THE New York correspondent of *Engineering*, London, gives in a recent number of that paper the following interesting narrative:

For a number of years it has been the desire of the engineers of the United States to entertain a visiting body of those of their profession from a foreign land. This idea was stimulated by the trip made in 1889 by the engineers of this country to England, France, and Germany, and it was hoped that the occasion of the Columbian Exposition might be the excuse for returning the elegant and lavish hospitality we had received when abroad at the hands of our brothers in the profession. It was only necessary to announce the project in the United States to have it met by enthusiasm and a liberal response in the shape of money. Among the other prospective visitors none was more anxiously expected than the Institution of Civil Engineers of Great Britain and their genial and efficient secretary, Mr. James Forrest. But in this respect we were doomed to disappointment. Yet such was the desire to receive them, that it was not till a positive statement from Mr. Forrest that he could not possibly arrange this that we reluctantly abandoned it. France, however, was not lacking in acceding to our demand, and the body of men who responded, although small in number, comprised some of the most important members of the profession, not only in France, but in the Netherlands, in Roumania, and in other adjacent countries. They were evidently what our French friends call "men of affairs," occupying prominent positions, and being themselves men of cultivation and of much general information. Although most of the visitors had never been in America before, yet they seemed to take kindly to our methods, and to enjoy all the novelties set before them, and, further, to fully appreciate all means taken for their pleasure and comfort, while they heartily entered into every plan presented by their hosts.

The arrangements were inaugurated on Sunday, when a party of Americans went down the bay on the Feiseen (the Japanese name for flying arrow), the fastest craft afloat, to meet and welcome the visitors. This boat, the property of Mr. W. B. Cogswell, was kindly placed at the disposal of the committee, and



MOUTH OF THE NERVION RIVER, BILBAO, SPAIN, SHOWING THE PALACIO MOVABLE BRIDGE AND TOWERS.

when it is borne in mind that the boat has a record of 31⅛ miles in an hour, it will be seen that the Feiseen justified her name, and that we could not have had a better chance to show our guests the greatest triumph of marine engineering. The little boat, 74 ft. long, sailed around the Champagne as though the latter was at rest, while nature seemed to lend herself to the entertainment, for the day was bright and sunny, and New York Bay never looked more beautiful.

As soon as the steamer was made fast to the dock, a party of Americans went on board and welcomed our guests in their own language, the address being pronounced by a native-born Frenchman who has lived in New York for twenty-five years, and now occupies the distinguished position of chief engineer to the Croton aqueduct. The party were then transferred to their hotel in carriages, and left to meditate on the difference between a New York and a Parisian Sabbath. The contrast was all the more marked because New York at this season is almost deserted.

The next day our guests assembled at the Engineers' Club for a breakfast, and were then taken in carriages for a drive through Central Park, where a visit was made to the Gate House and other points of interest under the control of the Croton aqueduct.

Cable cars were taken to Washington Bridge—that immense steel arch at 188th Street—and a view was had of High Bridge and the new bridge under construction at Seventh Avenue and 155th Street.

The day closed with a tour of Riverside Drive, a view of General Grant's tomb, and a visit to the General Electric Company's works, our guests being returned to their hotel at 6 P. M.

The next morning we found our visitors wide awake and full of enthusiasm. By invitation of Mr. Geo. W. McNulty, chief engineer of the Broadway Cable Company, our foreign friends were taken by the cars of that company to the power house at 50th Street, where the machinery and cables were examined, and they were then, by invitation of Colonel Hain, general manager of the elevated roads, treated to their first ride on that structure, which called forth many favorable comments from them. This trip comprised a journey over the entire elevated system.

By noon the party were in the Equitable Building, and were shown the process by which we had arranged such fine weather for them at the United States Signal Station. They were very much interested in the apparatus, and asked many questions, seeming to grasp the somewhat startling idea to them of the extent of this country, and the ease with which the various reports from so many thousand miles of territory were received and classified.

The various dinner bells implanted by a beneficent Providence in the interior of every human organization had been ringing sharply for some time, and this suggested that "civilized man cannot live without cooks," so all sat down to a fine lunch in the banquet hall of the Cafe Savarin.

The creature comforts, both solid and liquid, having been carefully "stowed away," to use a nautical term, sightseeing was resumed, and the Post Office and Brooklyn Bridge were next examined. The bridge called forth many enthusiastic remarks, as it deserved to, being the largest and most beautiful suspension bridge in the world, and having been thoughtfully embellished by Superintendent Martin with an American flag on the Brooklyn pier and a French flag on the New York pier. Again the elevated railway was called into service, and our party, in response to an invitation from the New York Central Railway, went to the Grand Central Station and examined the terminal facilities, switch signals, etc.

The Railroad Men's Club was a novel and interesting sight. This is in a spacious brick building, adjacent to the Grand Central Station, and is the donation of the Vanderbilt family. Here, by the payment of ten cents per month, any employe can have the use of the building, reading room, baths, and gymnasium. He may also find lodging, provided there is a vacant room. The value of this to a single man is simply incalculable, and ought to foster a most kindly spirit between employer and employe. This closed the programme for the day, and our party reached their hotel at 6 P. M., tired, perhaps, but assuring their hosts they had spent a delightful and instructive day.

The following morning we were forced to rouse our guests at an early hour, for we had a pretty full programme to carry out.

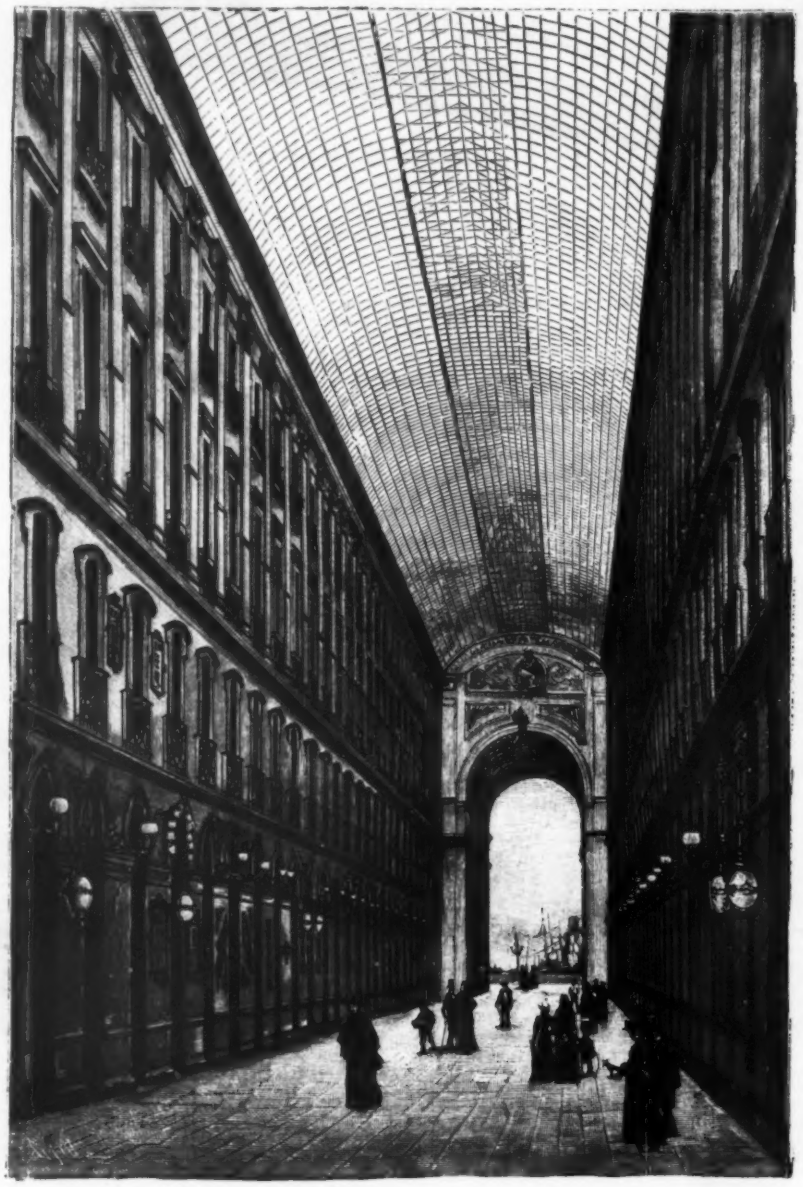
They embarked on the steamer Laura M. Starin, which was chartered for the occasion, and steamed up the East River, where views were afforded of Blackwell's Island and Hell Gate, the scene of General Newton's triumph, about which our visitors seemed to have a clear and correct idea. Indeed, it was remarked more than once how much they knew of the engineering features of this country which they had never seen, and this established them at once in the minds of their hosts as men of great general information. Our point of destination was the De la Vergne Refrigerating Company, where we were received with great cordiality, and conducted through their works. These works are most interesting, and notwithstanding the fact that the general manager's recent death had cast a gloom over the officials, yet everything was done to entertain and to explain. The massive machinery was greatly admired, and the completeness of the plant called forth many expressions of praise. The absence of great lines of shafting was the object of remark, and this was soon explained by the fact that each machine is run by its own electric motor.

After an entertainment in the dining room of the works, which is run on the plan of a restaurant for the employes, the party re-embarked, and were speedily under way. We passed on the easterly side of Blackwell's Island, saw the entrance to the Brooklyn Navy Yard and the great warehouses of Brooklyn, took a look upward at the East River bridge and a side look at Governor's Island and New York City, and halted opposite the noble statue of Liberty, that most thoughtful and exquisite gift of the French people to their American friends. The features of M. Bartholdi's great work seemed to wear a smile of welcome, and it was regretted that its eminent author, who was in New York, could not have been there to see, with us, this noble effort of his genius.

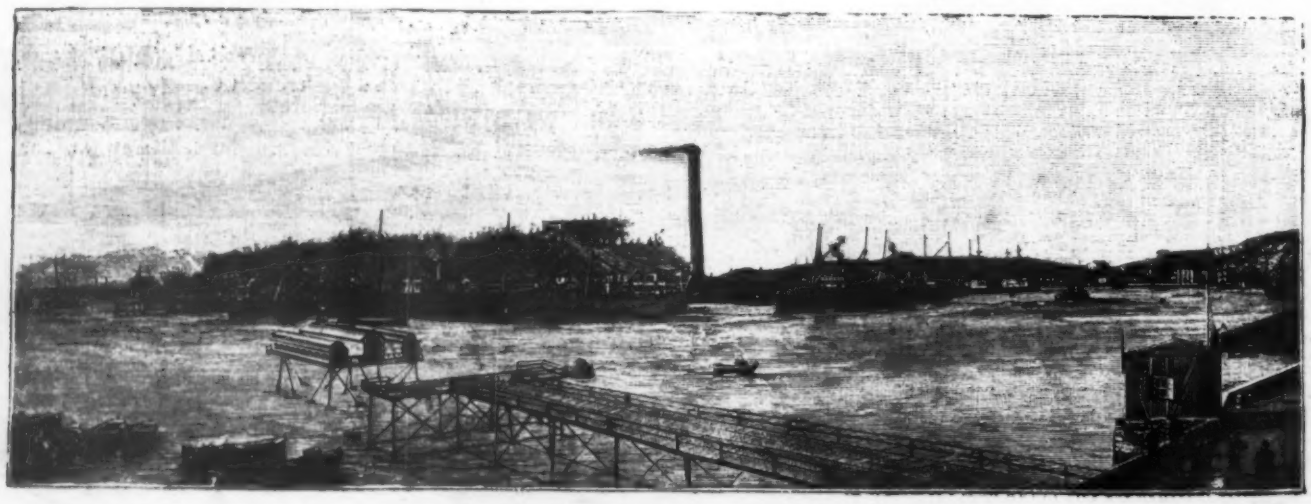
The party had their attention called in passing to the work of the dock commission, some of whose engineers were on board, and a blast was promised, but like the baby on exhibition, it wouldn't show off, and we were compelled to proceed "unblasted."

The wonderful steamers of the Fall River Line, which have been fully described and illustrated in *Engineering*, were next visited. The writer, who had planned this trip, selecting them as not only beautiful specimens of marine architecture, but as a novelty to a foreigner. The conditions calling them forth do not exist abroad, hence American hosts are sure they will prove a surprise to foreign guests.

The Plymouth was first examined, and her massive engines called forth much admiration from the visitors. Steam was applied, and the engines revolved a few times, showing their workings in a most praise-



COVERED PASSAGEWAY OR GRAND GALLERY, BRIDGE BUILDING, BILBAO, SPAIN.



THE TRAVELING BRIDGE, BILBAO, SPAIN.

worthy manner; and then the state-rooms and saloons were inspected, after which the party crossed the dock and boarded the Puritan. If admiration was the feeling expressed on the Plymouth, absolute astonishment was depicted when our French friends saw the Puritan. They could hardly find words to express themselves, even in that most fluent of all languages, their native tongue.

One gentleman said to the writer, on seeing one of the large state-rooms: "This is not a cabin, it is a chamber." The electric lights were turned on, and added to the beauty of the scene, especially to the appearance of the grand saloon. The officers of the line were represented by Mr. Lovell, Mr. Gardner, the general manager, Mr. Pierce, the chief engineer, and Mr. Taylor, the general passenger agent. Added to them was the veteran engineer, Mr. Andrew Fletcher, whose triumphs of skill have never been surpassed, and who twenty-five years ago built the Mary Powell, a boat which to-day holds the record as the best steamer afloat. He looked proud of this work of his, as he had every reason to be, and yet was so modest that he had to be sought for and presented to our French friends. It may be mentioned that these marvelous boats cost $1,250,000 each.

The Fall River Line, it should be remarked, never does anything by halves, and when the party were invited to inspect the dining saloon, they found there a beautifully decorated table, full of everything to tempt the appetite, and the wine of their native land to assist its assimilation as well as to hasten its departure. The walls of the rooms were beautified by French flags, festooning them in a most graceful and attractive manner, while behind the guests' chairs stood a row of colored waiters in uniform brought into bold relief by the white background of the cabin. Their glistening teeth showed a welcome to the foreigners, who regarded them with almost as much curiosity as anything they had seen.

The president of the French engineers felt moved to make a suitable and agreeable speech in response to a hearty welcome given by Mr. Lovell, and soon the room resounded with merriment, punctuated at proper intervals by the cheery popping of the champagne corks. It was hard to get our guests away, but other matters called us out, and we reluctantly left our genial hosts one hour later than the programme, and steamed across the river to the Pennsylvania Railroad station, where the party was met by Mr. Woolcott Jackson, general superintendent, and Mr. Crawford. These gentlemen conducted the party through the station, showed them all the various arrangements of this perfectly equipped railway, and took them outside to the signal towers, which at once fixed their attention. The party were then shown through a model vestibule train, and after seeing the transfer boat, where the freight cars are run on, and conducted around the harbor, we bade farewell to our entertainers, and steamed up the Hudson.

In passing Mr. Fletcher's yard, attention was called to the new boat in process of construction for the Fall River Line, and a few whistles of salutation were sounded. Just at that moment the Mary Powell, as if to bear tribute to Mr. Fletcher, darted out of her dock and started up the river. We had a sort of dissolving view of her, for her speed was nearly twice that of our boat, and she was soon out of sight on her daily trip to Newburg. Another of Mr. Fletcher's successes passed us on our way, the speed of which nearly equals that of the Mary Powell. Our guests saw a portion of the Hudson, admired the Palisades and the beautiful towns clustered along the banks of the river, and were, about 4:30 P. M., invited to a "petit souper," to which one man replied, accompanying the words with a most pathetic but despairing gesture: "I thank you very much, but I have no longer any stomach."

The party returned at 6 P. M., and if the writer can understand the full import of the French address made on the forward deck before landing, they had a good time.

The next day was put down as "the respite," as we thought our guests might desire leisure to arrange matters before their departure. However, a large number of them accepted the invitation of the Worthington Company to visit their works in Brooklyn, and that evening they entertained a number of the committee at their hotel.

The next morning a fine vestibuled drawing room train was placed at the committee's disposal by the authorities of the New York Central Railway Company, to convey their guests to Niagara Falls. This favor was highly appreciated by hosts and guests, and will undoubtedly result in a most favorable opinion of this splendid road, both in America and in France. The train was of the best type, and had all the modern improvements for luxury and comfort which have marked the administration of this celebrated line for many years. A dining car of latest pattern left nothing to be desired, and the train glided out of the station on its happy mission with hardly a motion, which was remarked by the visitors, and spoke well for the roadbed, as well as for the high character of the rolling stock. One enthusiastic Frenchman told the writer with considerable amazement that when the speed was sixty miles per hour he could write as easily as in his own house.

The Hudson never looked more attractive than when viewed from the wide windows of the Wagner car, and the French gentlemen remarked on it, saying there was nothing in Europe to compare it with, even the Danube being inferior in beauty. West Point was pointed out, and the Catskill Mountains, which formed a most suitable background to the scenery.

Albany was soon reached, and the party sped along the lovely Mohawk Valley, that garden spot of the Empire State; later, dinner was served in the usual excellent style of the Wagner Company, and several of the party rode on the locomotive by the courtesy of Mr. Buchanan. The Central Railway did everything that could be desired to show their guests how heartily welcome they were. A day was profitably spent at Niagara Falls, and after the wonders of nature had been viewed and a drive to Dufferin Park completed, the visitors were shown man's practical handiwork in the shape of the Niagara Falls tunnel, the canal and the wheel pit, under the guidance of representatives of the Niagara Falls Construction Company. At night the party were safely placed in sleeping cars and sent on their way rejoicing. This courtesy and the remainder of the trip to Chicago were the gift of the Michigan Central Railway, and came to us through the good offices of the Hawks and Mr. Jesse Smith, both of the American party of 1889.

Mr. Walter Russel, another of the same party, met our guests at Detroit, and assisted greatly in entertaining them. The passage of the Detroit River on two large ferryboats, which took the whole train, was also of great interest to the foreign gentlemen.

The party were immediately taken on board special electric cars courteously provided by the Citizens' Street Railway Company, conveyed along Jefferson to Woodward Avenue and thence to the end of the line at Piquette Avenue. They returned, and at the foot of Woodward Avenue boarded the ferryboat Promise, which had been placed at their disposal by the Detroit and Windsor Ferry Company. They went up the American channel, round Belle Isle, and down the river past the fort. The weather was superb, and everything appeared under the most favorable auspices. The Frenchmen were delighted with the trip, and were profuse in their compliments on all they saw. They were alike impressed with the natural beauties along the river, as with the magnificent body of water which formed so important a highway for commerce in the interior of the country. When they returned to the foot of Woodward Avenue they were escorted to the Detroit Club, where they sat down to an excellent luncheon in the large banquet hall. There were sixty in the company, including the escorts and George H. Barbour, president of the club.

Any one who has had the good fortune to be entertained at the Detroit Club knows exactly how it was done on this occasion, and to those who have not had this good fortune, it may be simply said: "Go yourself, and you'll know what it is to live on the fat of the land!" Good humor and jollity prevailed, and compliments flew fast in French and English, till an outsider might have imagined that another angel had descended and repeated the miracle of the Tower of Babel: but farewells had to be said at last, for the Michigan Central's special had a schedule to maintain. The journey to Chicago was accomplished speedily and without incident or accident, as is usual on this well-equipped and smooth-running railway, and our party was handed over in good order to the Chicago local committee the next morning, where they were safely left to enjoy the Fair, and, on the conclusion of their visit, to make a further trip around the United States, in the course of which they will visit St. Louis, Pittsburg, Washington, and Philadelphia, returning to New York in time to take the steamer for France on September 30.

ICE HOUSES.

FROM a domestic encyclopedia which was published in Philadelphia about one hundred years ago, the following description of ice houses as built in those days has been compiled.

An ice house, says Mr. Moase, may be built at very great expense, but it may also be built for a sum which no farmer, however poor, ought to object to. If he wish one, he may have it. At Gloucester Point tavern, below Philadelphia, on the banks of the Delaware, is an ice house which fully shows with what little expense, in how simple a manner, and under what supposedly disadvantageous circumstances an excellent ice house may be built.

The ice house alluded to is sixteen feet square; four feet above and nine feet below the surface. The marshy nature of the soil does not permit a greater depth. The pit, which slopes a little, is lined with logs as far as the surface, and faced with slabs, which are continued above ground. There is a sink at the bottom covered with logs, upon which the ice rests, and this sink empties into a pipe, which conveys the water of the melted ice or of the river to a hogshead sunk about eight or ten feet from the corner of the house, whence it is pumped up by a common ship pump. A thick bank of earth is thrown up outside as high as the ice extends. The roof is boarded, and the entrance is through a small door at the gable end next the tavern, which is south of the ice house and but a few feet from it. Straw is liberally used to cover the ice and to line the pit. A large willow shades the ice house on the northeast and west, and the tavern protects it on the south. The ice house holds ninety-one horse car loads and keeps ice enough to supply the house until the succeeding winter in which it is filled.

The Gloucester ice house may be considered as a valuable model for all those who wish to enjoy this summer comfort, and who live in marshy countries. But in dry situations other plans may be adopted. The following is recommended by Mr. Thomas Moore, of Montgomery County, Maryland, in an excellent treatise on the subject:

"The most favorable situation is a north hillside, near the top. On such a site open a pit twelve feet square at top, ten at bottom and eight or nine feet deep. Logs may be laid round the top at the beginning, and the earth dug out, raised behind them, so as to make a part of the depth of the pit. A drain should be made at one corner. The spout to carry off the water should descend from the pit, except a short piece at the outward extremity, which ought to be bent upward a little, thus forming a depressed part, which will always stand full of water, and prevent communication with the external air. Dig holes in the bottom of the pit, and set therein four perpendicular corner posts, and an intermediate one on each side: let the insides of these posts form a square of eight feet in the middle of pit. Then in order to avoid dampness from below, cover the bottom three or four inches deep with dry sand, if it can be conveniently got. The next thing to be done I consider the most material and also expensive part of the business, which is fixing a proper floor for the ice to rest on. In order to do this let three or four foot sleepers, supported at the ends, be placed across the square included by the posts; their upper edges about a foot from the bottom, but so that the plank laid thereon may have a descent of a few inches toward one of the sides next the drain. The plank should be two inches thick and about half seasoned, jointed, grooved and tongued or lathed, and grooves cut near the joints in the upper side, so as to prevent any water from going through. The floor must extend a little without the inner sides of the posts, so that the water dripping from the sides may fall on the floor. Then fix a plank or spout at the lower end of the floor in such a manner as to convey the water into the drain. The floor being completed, begin at the bottom plank up on the insides of the posts, with three-fourths or five-eighths plank (boards), lapping the lower edge of each a little on the one below, so that the water may be kept on the inside; this done to the top of the posts (which should be even with the top of the pit) and the inside will be completed, except that it will be proper to cover the floor with loose plank, previous to putting in the ice. The roof may be composed of any materials, and in any form that will defend the contents of the pit from wet, from the direct rays of the sun, and also admit a free circulation of air. I do not think any could answer the purpose better than one made of thatch, supported by posts a few feet from the ground. The mode of filling the house remains now to be considered, and on this much depends.

"Early in the winter fill the interstice between the ice chamber and the bank with clean dry straw, closely pressed; this being done early will prevent the earth from freezing, which would be injurious to the sides of the pit. The ice should be collected in the coldest weather. Let it be exposed at least one night to the cold atmosphere, after it is removed from the water, which will reduce its temperature many degrees if the weather is severe. When put into the house it should be beat small, and I think it would be useful frequently to sprinkle it with a watering pot, while putting in; the mass would by that means be rendered more compact. When the chamber is filled, cover the whole with a good thickness of straw, but I should suppose it would be best to cover the ice first with plank, supported by the sides of the chamber, only leaving a door to descend through.

"Such a house as has been described will contain about ten tons, and I am persuaded will be found sufficient to afford an ample supply for almost any private family.

"This is nearly the kind I had in view when I estimated the expense would not exceed $20; and if we calculated on a great part of the work being done by the family, which in the country in general it very well may, the actual outlay in many places need not be $5. Those who are less sparing of expense, if they choose, may wall, or what is better, plank up the sides of the pit, and finish the roof in a style of elegance.

"In level situations, where a drain cannot be conveniently dug out from the bottom of the pit, I should suppose it would answer very well to inclose the ice by a mound raised entirely above the surface of the earth, through which the water may be discharged; in other respects to be similar to the foregoing description. This, perhaps, would not be quite so cool a repository as if under the surface of the earth, unless the mound was very thick; but I am persuaded that the loss of a few degrees in temperature bears very little proportion to the advantage resulting from dryness.

"If it were certain the floor would be perfectly tight, the passage of heat to the ice would be rendered still more difficult by confining a quantity of dry ashes, sawdust, straw, or some other non-conductor between the floor and the bottom of the pit."

In Italy, where ice is much used, both as a medicine and in diet, it is formed in the following manner: Balls of snow are wetted, and placed one on another in the ice house. The bottom parcel rests on logs, through the interstices of which the dissolved water drops; and the whole mass is formed into a solid body of ice in the course of the winter.

The following points should be carefully attended to in building an ice house:

First.—Whether the pit is lined with stone, brick or logs, a vacancy should be left of at least one foot between the surrounding earth and lining, and filled with straw. The quality possessed by straw of slowly conducting heat is advantageously acted upon, in many instances by those who are ignorant of the principle, which is finely illustrated and proved by Count Rumford. A second wall, leaving less space between it and the first than between this and the surrounding earth, and likewise filled with straw, would tend more effectually to exclude the heat, which is commonly observed to cause a great waste of ice at the sides. Straw should likewise be liberally used between the wall and body of ice.

Second.—A chimney to convey away the heated, moist air is an essential requisite to all ice houses not much used, and which are placed in unfavorable situations; it is the want of this chimney which occasions the disappointment of many persons anxious to preserve a supply of ice in summer.

Third.—Mr. Moore suggests the probability of a thatch roof being equal to any for the purpose of covering an ice house, but there can be no room for doubt of straw being the very best material for a roof within reach of the farmer. If a single roof be used, the thatch should be as thick as possible, but a double roof (each roof being thatched) would more completely keep out external heat. Where the roof consists of boards or shingles the inside may be covered with straw, to be supported by battens.

In South Carolina and Georgia, where the ice must be imported from the Northern States, still greater precaution is necessary. The space between the double roof may be lined with powdered charcoal or ashes, which are well known to be the worst conductors of heat. The body of charcoal need not be more than six inches thick.

Fourth.—A floor over the body of ice would further protect it from waste by excluding heat. This floor should be covered with straw, and also have a door to enable a person to descend to the ice.

Fifth.—Ice houses should be filled in the coldest weather, and the ice broken into lumps about the size of a man's head. Cold water may be dashed on every layer of ice, but salt must not be used. During very cold nights the door of ice house should be left open.

Sixth.—Pits for ice houses should be dug down to gravel, or have a drain to carry off the dissolved water.

The same author also devoted some attention to the construction of a portable ice box, in which farmers might carry their butter and meat to market in order to obtain for them extra prices. The one which he made for this purpose he describes as follows:

"I had a cedar vessel made in the form of an oval tub, nearly as wide at bottom as top; in this was fitted as large a straight-sided tin vessel as it would contain, open at top. The interstices between the sides of the two vessels were covered by an edging of tin, soldered to the upper edge of the tin vessel, and extended on to the upper edge of the wooden vessel, to which it was nailed (but this edging ought to have been wood). Through this last was cut a hole about an inch and a half space on each side, for the purpose of putting in ice; over the whole was fitted a wooden lid, fastened by a hinge on one side. A coat or case of coarse cloth, lined with rabbit skins, the fur side next the cloth, and the pelt next the wood. The coat was in two parts for the convenience of raising the lid; the part attached to the lid had an edging which hung down and covered the joint which shut. The tin vessel was fourteen inches long, six wide and twelve deep, and contained twenty-two pounds of butter wrapped in linen cloth, and put in edgeways." The machine, the author adds, or similar ones constructed on the same principle, may be applied to a variety of purposes in families.—*Ice and Refrigeration.*

PORTLAND CEMENT.

SIXTY-EIGHT years have elapsed since the discovery of Portland cement, and during that interval its use and importance as a structural material has increased with such unprecedented rapidity that at the present time it is almost universally adopted wherever an hydraulic cement is required. It does not appear, however, that our knowledge of the physical and chemical properties of this material has quite kept pace with its increased use.

The divergence of opinion among engineers on many points connected with the testing, manufacture and occasional failure of cement indicates that its nature and properties are not yet thoroughly understood. Some engineers, for example, are of opinion that the presence of more than 2 per cent. of magnesia in cement produces fatal consequences, while others hold that magnesia may be considered as an inert and harmless adulterant. Some are strongly in favor of exposing fresh cement to the action of the air, or, as it is called, "air slaking," before use; others believe that it becomes deteriorated by such exposure, and so on through many other details.

Each engineer frames his specifications in accordance with his own particular views, and manufacturers have rather a bad time while endeavoring to meet the varying conditions imposed upon them. Differences of opinion must naturally continue to exist so long as our knowledge of the material remains imperfect, but there seems good reason to believe that at least some of the differences which at present prevail could be cleared up and eliminated. With this end in view we shall endeavor to epitomize and consider as briefly as possible the facts bearing on the subject which have been elicited by experimental researches or have been established by practical experience.

It cannot be considered desirable that the engineer should trench upon or interfere with the functions of either the chemist or the manufacturer, and it is to be regretted that a tendency in this direction appears to have recently developed itself in the matter of Portland cement, the chemistry of which is acknowledged to be of the most intricate and complicated character, and the manufacture of which requires an amount of skill and experience peculiar to itself, which engineers cannot be expected to possess. Under any circumstances it is best to leave chemical questions to chemists; and interference with manufacturers is to be equally deprecated, not only because they must know their own business best, but because the engineer, by unduly dictating how the cement is to be manufactured, takes upon himself the responsibility which should be borne by the maker.

M. Le Chatelier has expressed an opinion that there is at present only one way of determining whether the judgment passed on a cement by any system of testing is sound, and that consists in waiting half a century to see how the work stands. This statement cannot be said to be at present without some force; it is, however, much too sweeping.

The permanence of the work depends quite as much on the intelligent and judicious use of the cement as on the cement itself; the want of permanence, therefore, would not always prove the use of defective cement. For the reasons already indicated, we shall not enter upon the question either of the chemistry or manufacture of cement further than a brief elementary outline.

So far as regards its active constituents, the average composition of good Portland cement, deduced from a number of analyses (omitting fractions), is as follows:

	Per Cent. by Weight.
Lime (Ca O)	60
Silica ($Si O_2$)	22
Alumina ($Al_2 O_3$)	11

the remaining 7 per cent. generally consisting of small quantities (rarely exceeding 1 or 2 per cent.) of oxide of iron, sulphuric acid, magnesia, carbonic acid, potash, etc. The active components lime, silica and alumina are obtained, the first mentioned from chalk or limestone, and the two latter from clay (such, for example, as is found in the Medway), and occasionally from clay slate. The chalk and clay, both being in a state of minute division intimately mixed together, and brought to a plastic condition with water, are burned in a suitable kiln, producing a hard, heavy, vitreous clinker, which, when ground to an impalpable powder, is Portland cement in its anhydrous condition. The production of good cement appears to depend mainly on the degree of heat applied in the kiln, and the time for which it is maintained, both of which can only be determined at present by the skill and experience of the manufacturer.

The chemistry of cement, as before observed, is of an extremely complex character, and cannot be said to be fully understood. For many years Portland cement was considered to be a double silicate of lime and alumina; but recent investigators have come to the conclusion that tri-calcic silicate and tri-calcic aluminate are its principal constituents, the lime combining with the silica and alumina under the influence of heat in the process of burning. When the anhydrous cement is mixed with water, further chemical reactions occur, resulting chiefly in the formation of hydrated silicate and aluminate of lime, both of which resist the action of water, and in this way the setting or hardening of cement is accounted for.

The usual tests at present applied by engineers to cement refer principally to (1) the tensile strength of cement gauged both neat and mixed with sand; (2) the degree of pulverization to which the cement is reduced; (3) the weight per bushel of the dry ungauged material, (4) color.

To these is occasionally added the effect of submergence in water on thin slabs of cement gauged neat, *i. e.*, without sand. There are, however, many other points connected with the subject which require to be investigated before a proper knowledge of the material can be obtained. The principal of these are as follows: Adhesive strength, chemical analysis, specific gravity, quantity of water used in guaging, time occupied in setting or hardening, the influence of sea water as compared with that of fresh water, the effect of heat in accelerating the chemical changes produced by admixture with water, air slaking, testing machines, and the causes of occasional failures.

As regards the tensile or cohesive strength, the systematic testing of cement was first introduced about 34 years ago (1859) by Mr. John Grant, M. Inst. C.E., who specified that briquettes of cement gauged neat should, at the end of seven days, bear a tensile strain of 400 lb. on an area of 1¼ in. × 1¼ in. (= 2·25 square in.), or 178 lb. per in. This was shortly after raised to 500 lb. on the same area, or 222 lb. per square in. Since then the tensile strength has increased up to 400 lb. and occasionally 450 lb. per square in.; while 28-day samples were required to bear 550 lb. to 600 lb. per square in.

Within the last two or three years, however, the standard for 7-day samples in this country has been lowered from 400 lb. to 350 lb. per in., for reasons which will be subsequently referred to.

The necessity of testing the strength of a mixture of the cement and sand was recognized and adopted in Germany for many years before it had received in England the attention it deserved, and even at present many English specifications continue to omit this test, which is a far more important one than that of neat cement.

It is difficult to understand why the tensile strength of neat cement should have occupied such a prominent position as a practical test. The material is very rarely used neat, but, on the contrary, is generally mixed with large proportions of other materials, such as sand, shingle, etc., and even in this condition is seldom or never called upon to resist tensile stress. Cement may be considered practically as a kind of mineral agglutinator, and, as such, it is most probable that its tensile strength does not indicate either its cementing power or its permanent durability—for example, fine grinding diminishes the tensile strength, but increases the cementing power; it is also well known that to produce high tensile strength involves over-liming the cement, which is fatal to its durability, and for this reason the standard has been reduced to the extent already referred to.

The sand test, as most of our readers know, is made by mixing together one part by weight of neat cement to three parts by weight of clean sharp sand which has passed through a sieve of 20 meshes and been retained on one of 30 meshes to the lineal inch. The German standard for the tensile strength of this mixture 28 days after gauging was first (1877) fixed at 114 lb. per square inch; but this was soon raised to 142 lb., and ultimately to 222 lb. per square inch. The sand test, as may be shown, furnishes additional evidence that the tensile strength of neat cement should not be depended upon as a proof of good quality.—*Engineering.*

OLIVE MEAD.

WE give a portrait of a young artist who is destined to reach unusual prominence on the concert stage. If talent, unusual intelligence, application and appearance can produce an effect before the public and in artistic circles, Olive Mead, the violinist, will make a career that will attract unusual attention. She was born, says the *Musical Courier*, in Cambridge, Mass., on November 22, 1874, and began to study violin when seven years old. The late Julius Eichberg became her instructor, and after studying under this well-known teacher she was placed in the hands of Franz Kneisel, the concertmaster of the Boston Symphony Orchestra, than whom there is no better and accomplished violin teacher to be found.

Under these masters and with assiduous studies Miss Mead has attained a command over the instrument and a technical force and ability, together with a powerful tone, that have made her concert playing features in nearly all the performances in which she has participated. Her style and expression are in the true sense of the word thoroughly artistic. She has participated in the concerts of several societies.

She has been the solo violinist at the Petersburg Festival of 1890, when she played with orchestra under Carl Zerrahn; also at the Rhode Island Teachers' Association in Providence in 1892, at the Helen Hopekirk recital in Boston, at the musicales of the Mozart Association of Richmond, Va., and at numerous other musical events of a nature in which such an artist would be useful and entertaining.

OLIVE MEAD.

Miss Mead is at present residing at 289 West Chester Park, Boston, and has already been secured for a number of performances for the coming season. Her repertory consists of the great standard violin works of Vieuxtemps, Sarasate, Wilhelmj, Wieniawski, Bach, Ernst, Joachim and the old masters generally. Among other advantages she uses an Andrea Guarnerius violin, from which she extracts a most exquisite tone quality.

BENJAMIN JOWETT.

BORN 1817, died 1893. Nearly sixty years have passed since Dr. Benjamin Jowett first went to Balliol with a scholarship from the well known London school of St. Paul's, and the whole of that period, from the day of his entrance into Balliol as a scholar to the day of his death, was spent in the service of the college and the university, but more particularly in that of the college. Thus, though his loss will be felt by the country at large, it falls more particularly upon Oxford, and most heavily of all upon Balliol. Scholar of Balliol in 1835, fellow in 1838, tutor in 1840, and master in 1870, he not only made Balliol the first college in Oxford in the matter of scholarship and distinction, but he also made Oxford itself a far more important factor in the life of the nation than had hitherto been the case. Of all her children, perhaps, the late master of Balliol gave Oxford the longest, the most faithful, and the most useful service. More than any other he helped to widen the extent of her teaching, and to break down every barrier that stood between that teaching and the common crowd. How far he has been successful will never be known. Already other names than his are associated with the work which he began, and very likely his first initiative may by this time be quite forgotten. Indeed, the

greater part of the lifework of the master of Balliol is fated to pass unacknowledged, unrecognized by the world at large; only his old pupils and his more intimate friends know how much they themselves and, through them, the world owes to the unobtrusive activity of the Oxford tutor.

As a scholar, more especially as a Greek scholar, there were not wanting critics who asserted that the Regius Professor of Greek was by no means the most exact or the most infallible of guides to the more abstruse niceties of that tongue. It is very possible; Professor Jowett had not the making of a German commentator in him. The question remains whether carelessness as to the exact value of Greek particles was not more than compensated for in his case by his extraordinary powers of interpretation. It is not only that his translations of Plato are masterpieces of English prose, but that they, by the merits of their wonderful lucidity and attractiveness, have multiplied a hundredfold the modern scholars of Plato. Less happy as a theologian, his essay on "The Interpretation of Scripture" brought down upon his head the abiding wrath of the Tractarian party, and something very like persecution. He ruined his first chance of becoming master of his college, Dr. Scott being preferred to him by a single vote, on account of the rumored heterodoxy of his views; and later on, when appointed to the chair of Regius Professor of Greek in the university, he was actually impeached by the uncompromising members of convocation, and for ten years deprived of his salary—the only thing of which they had the power to deprive him—for the same reason. He himself was the most tolerant of men; living in these days of universal toleration, it is hard to realize how that attitude on his part stirred the intolerance of his colleagues.

But the most notable aspect of Dr. Jowett's career is not to be found in the part that he played in dead and gone controversies, nor in his contributions to literature, valuable as some of them are, nor in the reforms which, as head of a college and vice chancellor, he succeeded in introducing into university life; but in his relation with succeeding generations of pupils and, through his past pupils, with the world at large. It would be an invidious task to choose out of the many of the distinguished names which are connected with Balliol College, and impossible to estimate the influence which, through them, its master has exercised upon the intellectual and even the political life of his time. He was not only one of the best translators of Plato, but he was also the best modern impersonation of the philosopher's hero. He played Socrates to many generations of English youth of every rank and social standing; and more than one Plato, more than one Alcibiades, owes much to his friendship and his teaching. Of his relations with the undergraduate in actual *statu pupillari* many amusing stories are told. One tale, a very favorite one at Oxford, would tend to show that undergraduate inability to sustain a dialogue must have proved a sad drawback to the Socratic method of instruction. It was his custom to invite an occasional undergraduate to share in his walk. One youth who had thus been honored preserved an awestruck silence until the pair reached the farthest turning point of their expedition, he then remarked that it was a fine day—it was raining fitfully—and receiving no answer, relapsed into a still more frightened silence for the rest of the journey. "Good night," said the master of Balliol, when they parted nearly an hour afterward, "I like your conversation, Mr. ——, though I cannot agree with that last remark of yours." The story is not a very good one, but it rather aptly illustrates the kind of feeling which the undergraduate entertained, as a rule, for the master of Balliol—affection, largely tempered with awe. It was impossible not to recognize the generosity and the kindness of heart that inspired every action of the man; but it was also difficult not to feel a shrinking dread of the rather caustic wit which seasoned most of his speeches. He was thought to be rather intolerant of stupidity; of frank stupidity he could be tolerant enough, but of either affectation or conceit he was most intolerant. The clever caricature, perpetrated by an old pupil—Mr. W. H. Mallock—in "The New Republic," gives one as imperfect an idea of the real Dr. Jowett, the man, as it does of his ideas as a philosopher. In one way he was a curious mixture of scholar and man of the world. He liked the company of distinguished people; he liked to entertain the great notabilities of his time, and to feel, perhaps, that he was a prophet in other countries besides his own; but never could he have been accused of going out of his way to seek for the social success which came to him so plentifully. On the other hand he was a scholar in the truest sense of the word, but yet always with a clear sight that scholarship was not everything, and that learning, however excellent, was not the end of all things. He formed a connecting link between the tranquillity of Oxford and the restlessness of the outside world which the former will find it hard to replace.—*The Graphic, London.*

BENJAMIN JOWETT, MASTER OF BALLIOL COLLEGE.

DIAZOTYPE PHOTOGRAPHY.

DR. J REYNOLDS, a Brixton physician, lately brought under the notice of the local camera club, of which he is president, some of his recent experiments with the diazotype, or, as it is popularly called, the primuline process. This process was described in these pages two years ago, directly after it was first made known by Messrs. Green, Cross and Bevan, at the Leeds meeting of the British Association, where it excited great interest, because of the brilliant and varied colors of the images producible at will, and because in it nitrogen is liberated by the action of light, in which, as well as in some other points, it differs from all other known photographic processes. After the reading of Dr. Reynolds' paper, Mr. C. F. Cross, who represented the patentees at the meeting, announced that in Germany some research has taken place in the matter, and that the German patent has been purchased by Messrs. Meister, Lucius and Bruning, of Hoechst-on-Main. Dr. Reynolds and Mr. Cross stated that the process had the peculiarity, when applied to gelatine, of producing images entrely free from grain, a quality exactly that which is wanted in photomicrography and in star charts, for under sufficient magnifying power the grain of gelatine bromide images always makes its appearance, and is commonly troublesome. The light yellow ground always present in primuline photographs is not usually sufficiently marked to be objectionable in lantern slides, both the oil and the lime lights being poor in violet rays; the yellow ground comes out more distinctly with the electric light. Mr. Cross stated that in the diazotype processes they are not limited to the use of primuline, and that a pale cream-colored ground can be obtained by the employment in its stead of dehydrothiotoluidinesulphonic acid, which, a listener sensibly remarked, must be a very fine acid to have such a name. Mr. Cross called attention to the fact that those who work any silver process are divided excessively in opinion as to the chemical changes which take place in some of its different stages. No such doubt hangs over the primuline process; all the reactions are exactly known and can be expressed quantitatively. A peculiar point is that the nitrogen thrown off during exposure to light is occluded when a gelatine vehicle is used, but appears in bubbles all over the image directly the gelatine-primuline film is dipped in water. He stated that they had now had two years' experience with the primuline process, and so far had not found that the colors in photographs produced by it had exhibited signs of fading. In ordinary photographic images produced by change of color by light, the color first formed obstructs the deeper penetration of the light, therefore its action also upon more of the sensitive substance below. With primuline this is not so. There is a change of color by partial bleaching before development, but the light still penetrates easily, so that several thin superposed sensitized films can be printed through at once. As to the amount of sensitiveness of diazotized primuline on a cellulose fabric, it was found at the meeting that an exposure of eight minutes was necessary to get a print close to the condenser of a lime-light lantern with a blow-through jet.

THE COLUMBUS RELICS AT THE WORLD'S COLUMBIAN EXPOSITION.

WITH the title of the Latin American Department, and under the direction of Mr. William E. Curtis, an organization was established at Washington in the summer of 1890 with the object of collecting every possible relic connected with the life and times of Christopher Columbus. To put this idea into effect, officials were dispatched to every place where Columbus was known, or was reported, to have been; in Italy, in Spain, and in North and South America. As the work of the organization proceeded, it was found to be much more extensive than was at first supposed; relics of the great discoverer were more numerous than could have been imagined, and in most cases they were freely lent; where this was impossible all facilities were given for the production of facsimiles. If the original idea was to confine the collection simply to the personal history of Columbus, it quickly received a great extension, and was made to include all available information about the alleged anticipators in the discovery of the new world, the history of the Spanish court during the Columbus period, and the life and times of the most prominent adventurers in the northern and southern continents that succeeded Columbus in the work of discovery and conquest. When this organization was fully under way, and it became evident that the collection would be one of considerable size and of intense interest, the question arose as to the manner in which the relics should be displayed. Then it was that Mr. Curtis proposed the reproduction of the convent of La Rabida at Palos, the asylum which was ever open to Columbus by the intelligent and hospitable Franciscan monks, whether he came to them to explain, with all the ardor of his great nature, the dreams of discovery upon which he lived, or whether he returned to them in triumph from the new world, or fled to them for shelter and protection against bigoted and miserable persecution. No happier thought than this occurred in connection with the great show at Jackson Park. Within the peaceful whitewashed walls of the rude cloisters, or in the cells or refectory, where one can imagine Columbus often to have inspired his hearers with the glow of his enthusiasm, or in the chapel where certainly he often knelt, the visitor can enjoy the calm belonging to this out-of-the-way corner of the old world.

The location chosen for the building is the best that could have been selected upon the grounds, and, indeed, it would be difficult to have chosen a more appropriate site. South of the Agricultural Hall the ground rises somewhat until it forms a miniature bluff on the lake shore. From this rise the long, low whitewashed walls of La Rabida, pierced with small square openings for the doors and windows, and surmounted by red heavy tiles of Spanish fashion. It is true that a length of rusty modern stovepipe protruding upward rather spoils the scene, but that is a detail. Standing with one's back to the south entrance of the Agricultural Hall, the picture is very beautiful. In front the picturesque irregular twelfth century structure; to the left the gleaming walls of the Casino, and the noble peristyle of Mr. Atwood that spans the mouth of the great basin, marred by the gigantic golden statue of Liberty that rises out of the water, a dazzling blot upon the landscape. To the right of the convent is an open space on which some dozen or more military tents are placed; they form the shelter of a military guard, the United States troops that, night and day, watch over the priceless treasures within the building. Fur-

ther to the right is the vast Krupp pavilion; then to the right again is an inlet of the lake, where rides secure at anchor an ancient New Bedford whaler, which had survived half a century of peril, and has come at last to be an exhibit at Jackson Park. Add to the picture the wide expanse of Lake Michigan, pearly blue to-day (for at last a few hours of sunshine have been vouchsafed to Chicago) as the Lido, and dotted here and there with sails and steamers, prominent among them the ancient side-wheeled guardian of the lake—the gunboat Michigan—and all that will be wanted is the fleet of caravels now on their tedious way from New York Harbor. They will, indeed, when moored beneath the convent, form a striking contrast to the bustling white high-sided steamers that are busy loading and unloading at the pier head that one sees stretching far out into the lake beyond the peristyle.

So much for the building and its surroundings. Let us take a glance at its interior, for this building is almost singular among the hundreds that crowd Jackson Park, in being practically complete. The whitened walls of the cloister and its cells are lined with Columbus relics, pictures, maps, and photographs; the main hall, reached by a flight of steep mediæval steps, is occupied with the originals or replicas of the seventy known portraits of Columbus, none of them truly authentic, and most of them absolutely mythical. In a large room below are the sole existing relics of the first so-called Christian town erected in the New World, together with cases filled with objects of the highest interest, acquired by discovery or purchase. In the chapel are displayed, under somewhat flimsy glass cases, numbers of priceless manuscripts, which will doubtless require the utmost diligent watchfulness of the National Guard to save them from becoming a prey of the unscrupulous relic hunter.

The whole of this collection divides itself into several periods, which are admirably referred to in the very complete catalogue prepared by Mr. Curtis. The first of these groups illustrate the amount of geographical knowledge before and at the time of Columbus. It comprises all the available evidence that could be collected to prove or suggest that the great adventurer had been anticipated in his discoveries. Scandinavia has put in a serious claim to this honor, and the evidence is sufficiently weighty to justify the exhibit in model of a Norse ship lent from the National Museum at Washington. By aid of this vessel Iceland was discovered in the year 860 A. D.; it is claimed that even at that time the bold voyagers had ventured across the Atlantic and had cruised along the greater part of the eastern shores of the North American continent. Leif Erikson is the individualized hero of these adventures. He is at least, an historical character, and it is on something more than tradition that his claim was based. As the story goes, he profited by the experiences of a returned castaway named Bjarne, and landed not far from where Boston now stands. So convinced are some able investigators of the true claim of Erikson that a statue has been erected to him in the city of Boston, and it is very interesting to note that in the year 1836 there was discovered near Fall River, Massachusetts, a skeleton, still partly clad in rusty and corroded armor. Investigations seem to point, undoubtedly, to its Scandinavian origin, and it was generally believed that the haphazard of the spade had brought to light the remains of Thorwald Erikson, the brother of the famous Leif. This somewhat vague evidence is, to a certain extent, corroborated by the Icelandic records of the fourteenth century, describing, 400 years afterward, and a century before Columbus, the Atlantic voyages and discoveries of Erikson and his band. Two very interesting maps are found in this part of the collection—one a copy of the Zeno chart, on which is laid down the course taken by the Venetian navigator near the beginning of the fourteenth century, and who, by good luck, reached Greenland; and the other, a facsimile of a map of the world, as known about 1450, by Paolo Toscanelli, an eminent friend and patron of Columbus. We must pause to notice a copy of the famous terrestrial globe made by Martin Behaim in 1492; it is the earliest globe known to geographers, and is about 21 inches in diameter. There is a variety of other maps and charts—some original, but most facsimiles; that one showing the world as Columbus imagined it to be is of great interest. He supposed that between the west coast of Africa and the eastern coast of Asia there was no land, except a vast archipelago, of which the East Indies formed the lower portion. The second section of this interesting exhibit contains pictures illustrating the time and court of Ferdinand and Isabella. Interesting as this section is, we must pass it by unnoticed; for while we feel we need no excuse for enlarging on the history of Columbus, we cannot attempt to stray into the field of general history.

The city of Genoa has decided that to it belongs the glory of the birthplace of Columbus, though Cogoleto and other towns dispute the honor. In any case, it appears clear that the parents of Columbus occupied a house at Quinto, about four miles from Genoa, and that from there they moved into the city in the year 1446; the house they lived in there, and in which Columbus was probably born, is identified and marked by a tablet; it was purchased for preservation in 1887. There seems little uncertainty about the details of his later career; he was educated at Pavia, where his knowledge of astronomy and navigation was acquired; he was married at Lisbon, where he settled as the most profitable place for the pursuit of his business, the making and sale of maps, for if Columbus had lived to-day in the country he discovered, he would be known as a book agent. Later, he resided for some years in Madeira—at Funchal and Porto Santo. Then, returning to Portugal about the year 1484, he paid his first visit to La Rabida on his way to the court of Ferdinand and Isabella, whose favor he hoped to gain to help him realize his dream of discovery. His hopes then were not to be fulfilled, and he returned after two years to pay his second visit to the monastery, a disappointed man. This, at least, seems to be the probable story, though there are theories which differ from this. In any case, it appears certain that when Columbus arrived at La Rabida he was quite destitute, but he did not seek for charity in vain; and more than this, he found in the superior a man of sympathetic tastes and learning, who, moreover, had been familiar with his efforts to interest the court of Spain, because he had been the confessor to the Queen. This was Perez de Marchena, who had not only indorsed the theories of Columbus, but helped him with all the power he possessed, and later was appointed astronomer to the expedition of 1493, although when the time came he remained at home. It was, in fact, owing to the influence of this powerful friend that Columbus was called back to the court to explain his plans to Ferdinand and Isabella, but they were once more rejected, and he left for France to try his fortune there. The interest that had been aroused by this time must have been intense, because, while on his journey, messengers were sent after Columbus to return, and at Santa Fé arrangements were at last concluded by which the enterprise was rendered possible. It was then that the famous incident occurred that has formed the subject for many pictures, and which is recorded on one of the Columbian series of postage stamps—the offering of her jewels by the Queen to pay the expense of the expedition. As the highest estimate of the expense is only 1,400*l.*, the treasury must have been very impoverished, and the estimate of the needs of an expedition extremely moderate. It was sufficient, however, and it did not include the cost of the fleet, because the town of Palos, for some previous offense, had been condemned to keep two caravels always at the disposal of the king. On August 3, 1492, Columbus took leave of his friend and patron, Marchena, and started on his unknown voyage. It is worth recalling that the flagship of Columbus, the Santa Maria, was only 120 tons burden; she was 63 feet long over all, 51 feet long on the keel, and 10 feet 6 inches in draught. She carried a crew of 70 men, or more than half the expedition, which, all told, was 120, with provisions for six months. As all the world knows, this fleet has been reproduced with all the accuracy possible, in Spain, by Lieutenant Little; the Spanish government undertook the construction of the flagship provided that the exhibition authorities built the two others. Congress, however, failed to make the necessary grant, and the idea would have been abandoned but for the generosity of Mr. Lyman Gage, who guaranteed the requisite outlay. Chicago thus owes to one of her citizens this interesting contribution to the World's Fair.

All available data referring to the landing of Columbus have been got together by Mr. Curtis, and the monotony of documents is relieved by a great variety of maps and photographs prepared for this exhibit. The spot where Columbus saw the lighted torch on the night of October 11, and which proved to him that his voyage was not to be fruitless, is generally agreed to be Watling Island, an outlying member of the Bahama group. But the exact spot where the landing took place the next morning, and the new continent was annexed to Spain, was a vexed question. To settle this point, newspaper enterprise stepped in, and during 1891 the *Chicago Herald* sent out a party to locate the spot. This has been done, and a monument has been built, so there can in future be no doubt on the subject. It is interesting to note that a careful survey of Watling Island had never been made till the *Chicago Herald* expedition undertook the work; a large map, the result of its labors, is exhibited, and with so much care has the work been done that the route of Columbus round the island, the place from which he saw the fisherman's night signal, and much more interesting information, are marked with great preciseness. One thing is quite clear: Mr. Curtis' collection of photographs of Watling Island is sufficiently large to include all the places where landing could have been possible. The manner in which the voyage of Columbus among the West India Islands is delineated is very admirable. Photographs of the coast where the Santa Maria was lost, on the Christmas Eve of 1492, are given, and searching here, the officer in charge of this part of the work found last year a fifteenth-century anchor. There does appear to be good reason for belief in the authenticity of this relic. Columbus erected a fort near the place where he was wrecked, and in an inventory of stores, in his own handwriting, an anchor is mentioned. In any case, the unanimous testimony of experts confirms the fact that the relic belongs to the period, if not to the expedition. By maps and pictures, the return voyage of Columbus to Portugal is illustrated, not forgetting the visit of himself and crew to the Azores, to return thanks in the cathedral there. Landing at Lisbon, he met with ill treatment, and with some difficulty made his way to Barcelona, where the Spanish court then was, to report the result of his voyage to his sovereigns. The brilliant circumstances of his reception are too well known to need repetition here; they are admirably represented by Mr. Curtis in a series of pictures, some original and others reproductions of well-known works.

The second voyage of Columbus was on a larger scale. He started from Cadiz on September 25, 1493, with three ships of 100 tons, and fourteen caravels. Reaching Havti, he found that the fort he had built was destroyed, and the small garrison murdered, so he made for San Domingo, and landed there to commence the erection of the first Christian town in the new world. It was called Isabella, and must have been on a very small scale, but it contained a church, a king's house and a governor's palace, all built of stone; the other structures were of wood and reeds. Of course, nothing but a heap of stones remains of this historic place, and these have been all collected, and now form part of the exhibit at Chicago. During their investigations, Mr. Curtis' party found many interesting relics, both among the ruins and belonging to residents. A large number of these are shown. The destruction of Isabella was hastened by the discovery of gold on the mountains, and a second town, called La Vega, was built. Relics from this are also shown, the most interesting being the first bell used for Christian worship in America.

The history of this bell is remarkable. It is of bronze, 8 in. high and 6½ in. in diameter; it bears the letter F on one side and a device on the other. It was hung in the tower of the chapel at La Vega in 1494; the place was destroyed by an earthquake about seventy years after, and for more than 300 years the bell was buried. In 1886 it was found among the ruins, and after careful investigation it was admitted to the cathedral of Santo Domingo as a sacred relic. Through the efforts of the Dominican minister to the United States, the bell was lent to the Exposition. Fragments of chain armor, stirrups, horseshoes, and other objects were found among the ruins of Isabella and La Vega. Among the remnants of weapons also found, one of the most interesting is the fragment of an old gun, called a lombard, which, after having been taken from a ship, was mounted on one of the forts constructed by Columbus for defensive purposes; a cannon ball made to be fired from this gun was also discovered.

The next group of objects collected by Mr. Curtis refers to the third voyage of Columbus, when, worn out by hardship and disheartened by intrigue, the flood of his fortunes had turned. This third voyage was undertaken in the summer of 1498, and it was then that he discovered the island of Trinidad and was nearly wrecked by the stormy waters at the mouth of the Orinoco, a river of whose existence he had no idea. An anchor which presumably belonged to this expedition was discovered at Trinidad, but the interest of authenticity that attaches to the one already referred to does not appear to belong to this relic. Reaching San Domingo, which by that time was under organized Spanish dominion, Columbus found himself opposed by the hostility of those in authority, who had been indebted to him for their elevation. A long string of charges was devised against him, and being found guilty of these, he was imprisoned in the citadel, where he was placed in chains and exposed to indignities. Finally, in 1500, he was sent back prisoner to Spain, and received by Isabella with enthusiasm and promises of ample restitution, which, like the proverbial promises of princes, were never fulfilled. Nevertheless, he was so far taken again into royal favor that he obtained permission and funds to fit out a fourth expedition, which left Cadiz in May, 1502. The fleet was a small one of four vessels, the largest of not more than 70 tons, and the expedition numbered 150 men. He was forbidden to enter San Domingo, but being driven into the port there by stress of weather, he asked, and was refused, permission to anchor. The Spanish governor at that time, Ovando by name, was on the point of setting sail for Spain with a large fleet. Among the passengers was the old governor, Bobadilla, who had sent Columbus home in chains two years before.

It is interesting to note that the whole of this fleet was lost in the storm from which Columbus had begged for shelter. It was only on this expedition that the great explorer landed on the American continent; the exact spot was Carxinas Point, in Honduras, and, in spite of all his physical suffering, he explored the whole coast of the isthmus from Yucatan to Colombia, and at last realized that an impassable barrier existed between him and his cherished hopes—that of a direct sea passage westward to the Indies. From his return from this last voyage in November, in 1504, to the following May, Columbus lay ill at the convent of Cartuja, and from this time his work was over; he died on May 20, 1506, in the same convent. During this short period he was closely associated with Americus Vespucius, a navigator who, following in Columbus' footsteps, carried his investigations much farther, and had the honor of naming the great continent. Columbus occupied the brief time remaining to him in writing a book to prove that his discoveries had been predicted in the Scriptures, and gave other indications that his mind as well as body had been broken by the adventures of his life. A number of relics have been collected, associated with the death of Columbus, together with many pictures and photographs relating to the same period.

He was buried in the chapel of the convent of Cartuja, and in 1877 his coffin was opened and some of the precious dust was presented to different people. A locket containing some of this dust is among the objects shown, as well as a series of photographs and facsimiles of caskets containing more. The greater portion, however, was collected in a gold and jeweled casket which is exposed on September 10 every year on the altar of the Cathedral at Seville, when a high mass is celebrated for the repose of the soul of the discoverer. It must not be supposed, however, that Spain is allowed to have the credit of being the burial place of Columbus, without dispute. Havana insists upon that honor, and appears to have the best of the argument, as the result of an official investigation has decided in favor of the Cuban capital.

The next section of the collection refers to relics of Columbus, chiefly autograph letters in original or facsimile; there are about twenty-five of these documents, some of them almost of priceless value. Coming now to the literature of the discovery of the new world, it will be found that Mr. Curtis has made a collection which will be the envy of American enthusiasts. The first is only a facsimile of the title page of the first book published on the subject; this was in the autumn of 1493, a few months after the return of Columbus from his first voyage. It is called a letter from Christopher Columbus, and six known editions of it were published during the same year, a sufficient proof of the excitement caused by the discoveries. Of the first edition but three copies are known, one of them being in the British Museum. Specimens of the second, fifth, and sixth editions are shown in the collection. One object of extreme interest is the famous Da Vinci map belonging to Her Majesty the Queen, and lent by her at the request of the President of the United States; on this map occurs the word "America" for the first time, so far as is known.

It is a curious fact that several letters passed between Columbus and Leonardo da Vinci, the celebrated painter of "The Last Supper," respecting a western passage to the Indies. They were written in 1473 and 1474, when Da Vinci was an engraver and mapmaker. There is also the original of the first chart of the West Indies, drawn upon an ox hide in 1500 by Juan della Cosa. A large number of books, documents, and pictures refer to the naming of the continent, and the immediate followers of Columbus. Such a collection of original papers relating to the subject has never before been brought together, and the fact that the Spanish government has been willing to lend these treasures demonstrates how deep an interest they have taken in the Columbian Exposition. The principal ones are letters from the King of Portugal to Columbus, dated 1498; the original commission by Ferdinand and Isabella, together with letters patent relating to the first voyage, all dated April 30, 1492; the will of Christopher Columbus, February 22, 1498; a large number of let-

ters from Columbus to his family and friends; a report addressed by him to Ferdinand and Isabella before starting on his second voyage; the agreement concerning his privileges and concessions, entered into between him and his sovereign; a rough draft letter book containing the autograph originals of his most important letters, and a number of other documents.

His Holiness, Pope Leo XIII., has taken an extraordinary interest in Mr. Curtis' researches, and has lent him some priceless objects from the Vatican, which are displayed in the convent building. Among these are some edicts of Pope Alexander V., dated 1493; they contain very striking evidence of the Papal power at that time, and of the very crude ideas which then existed on the most elementary conditions of commercial economy. Spain and Portugal were then rivals for the trade of the world, and conflicts between the two countries were frequent for supremacy. To put an end to these, the Papal edict was issued on May 3, 1493, giving Spain authority to sail west, and Portugal to sail south; in other words, decreeing that the latter country should control the trade with Africa and the East Indies, at that time fairly well developed; and that Spain should exercise the same power over the islands that had just been discovered in the new world, and over whatever might lie beyond them. On the following day a second edict was issued, about which we are told by Mr. Curtis, "The Portuguese ambassador at Rome, having under instructions from his sovereign questioned the discoveries of Columbus, the Pope issued a second edict, known as the Bull of Demarkation, commending the achievements of Columbus, and declaring that the Spaniards were entitled to possess, on condition of planting the Catholic faith, all lands, not already occupied by Christian powers, west of a meridian drawn one hundred leagues west of the Azores and Cape Verde Islands." This wholesale parceling out of the globe was destined to have effects not dreamt of even in the infallible mind of the Pope, and for many long years yet to come, the riches of the American continents were used to benefit the church, which made its influence supreme throughout all the new world. No time was lost in Rome in taking spiritual and indirectly practical control, as is shown by the bull dated June 25, 1493, appointing the first missionary priest to America, and conferring on him full powers to govern ecclesiastical affairs in the new world.

In connection with the famous Demarkation Edict is shown a map known as the Borgian map of America, which was finished not later than 1529, thirty-seven years after Columbus' first discovery. Upon it is the line traced by Pope Alexander VI., marking the areas assigned to Portugal and to Spain. This map was made by Diego Ribero, geographer to the Spanish king; it is not so complete or beautiful as another Ribero chart also shown and bearing the same date. An inscription on this map conspicuously states that all geographical knowledge up to date was inscribed upon it. It is divided into two parts, conforming to the agreement made between the kings of Spain and Portugal in the year 1494, and in accord with the Papal edict; it is dotted over with the banner of Spain on the west and that of Portugal on the east, and in all respects is a most remarkable production as a piece of map making. It bears curious evidence of the energy with which the work of exploration had been followed after Columbus had shown the way; no doubt the influence of the church had much to do with this, but, however that might be, the eastern coast of the North and South Americas had been carefully surveyed, and are plotted with remarkable correctness upon the map. Of the interior of the continent but little was known, and of the western coast, nothing. Before that date, however, a small party of explorers had penetrated to the Pacific coast across Mexico. But what, perhaps, is most remarkable in this chart is the completeness with which the dark continent of Africa is mapped out. The indications of churches marked here and there prove that Rome had been busy; the western coast was fringed with settlements, and the three great lakes in the interior of Africa, together with the source of the Nile, are shown with too much accuracy to permit the suggestion of an imaginative map maker.

We could extend our notice of this charming and extensive collection almost indefinitely, but our space forbids much further reference to the subject, at all events for the present. We must, however, make passing reference to the chapel attached to the convent, and, like it, a reproduction of the original. It is plain and crude enough, but its walls are covered with interesting pictures, including three very fine mosaics, and all lent by the Pope. It is in this chapel that are placed the various glass cases containing the priceless manuscripts already referred to. These are guarded night and day, as we have already said, by a company of United States soldiers. At one end, facing the east, is the chancel, and here will be placed a reproduction of the high altar of La Rabida. Already a copy of a famous relic is in place, no less a thing than that of the original cross made by Columbus for the church in the town of Isabella. Certain Franciscan friars, resident in Chicago, have made application to be permitted to say mass in this fictitious religious edifice, but it is probable that their religious ardor will have to be toned down to the more prosaic duty of distributing programmes and of giving information. Their presence, at all events, in any capacity would heighten the illusion, and help to increase, if possible, the attraction of this marvelous place. We have said that Mr. Curtis has got his collection practically in order, and this is so, but, like every other part of the Exhibition, it will better repay a visit a few weeks hence, when the little central garden within the cloisters shall be beautified with grass and flowers; when the approaches will be something better than penetrating sand or sticky mud; when the caravels will have arrived at their moorings, and the waters of Lake Michigan shall have put off the cold gray hue of spring, and shall have assumed the blue and gold of summer.—*J. D., in Engineering.*

LIGHT AND ELECTRICITY.

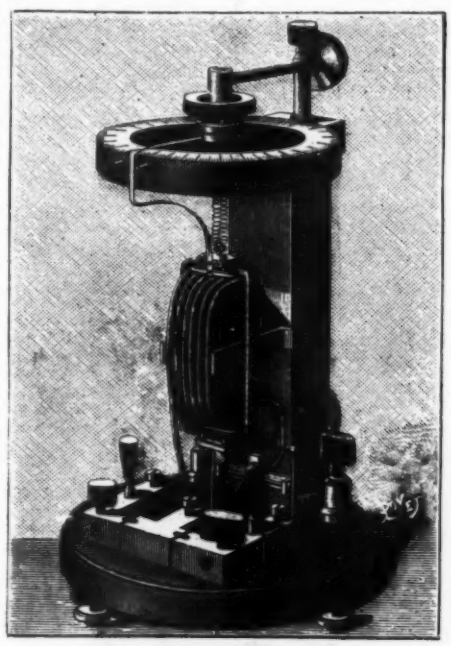
SOME interesting experiments carried out by Dr. G. B. Rizzio, and described by him to the Turin Academy of Sciences, have resulted in adding one more link to the chain of experimental correlations between light and electricity. By taking a number of precautions against oxidation, Dr. Rizzio succeeded in depositing transparent films of metallic platinum upon the interior of glass cylinders, with which he proceeded to make observations for the determination of transparency at different temperatures. These cylinders were placed in iron pipes in a small gypsum furnace, and heated by a spiral tube of small gas jets. Light was transmitted through windows in the iron tube, and a Krüss universal spectroscope was used to compare the spectra of the beams which passed through the glass and platinum and through the glass only. The temperatures were measured by the calorimetric method. After allowing for the various reflections undergone by the light, it was found that as the temperature rose the transparency of the platinum began to increase, especially in the more refrangible region. According to the electro-magnetic theory of light, both the resistance and the transparency of a conductor should increase, and the resistance and transparency of a dielectric should diminish with a rise of temperature. So far as these experiments go, therefore, they give results in perfect agreement with this theory.

MEASUREMENT OF THE ELECTRIC POWER OF ALTERNATING CURRENTS.

WHEN any electric apparatus is established upon a continuous current generator of electric energy, nothing is simpler than to determine the power that it absorbs.

The intensity of the current that traverses it is measured with an amperemeter, and the difference of potential at the terminals with a voltameter. The product of the indications of the two measuring apparatus gives the value of the electric power in watts.

It is not always the same with alternating currents. When the apparatus used is a simple resistance (an incandescent lamp, for example), the method is applicable. The product of the indications of a voltameter and an amperemeter appropriate to these currents gives, indeed, the value of the electric power furnished, but if we interpose a bobbin, an electro-magnet,



ZIPERNOWSKY'S WATTMETER.

a transformer, a motor, etc., the same is no longer the case. The power effectively furnished to the apparatus is always less than what would be deduced from the product of the indications of the two measuring apparatus.

It may, even, be null, in the case of a perfect condenser, and we then find the result, paradoxical in appearance, that an apparatus to which an intense current is furnished, and at the terminals of which an elevated difference of potential is found, absorbs a null electric power. It seemed to us that the question, very interesting in itself, of the measurement of electric power, under these peculiar conditions, presented too abstruse a character for the readers of this journal, and so we have hitherto hesitated to speak of it; but, in the presence, on the one hand, of the increasing development of the application of alternating currents and of the use of alternating current motors, and, on another hand, of the questions that are often submitted to us on this subject by our readers, we believe it our duty to give satisfaction to those whom the question interests by endeavoring, as rapidly as possible, to establish the principle upon which is based the apparatus that permits of effecting such measurement with precision whatever be the nature of the apparatus used.

Let us conceive of an electric generator furnishing at its terminals a periodical difference of potential of sinusoidal form, and let us establish a simple resistance between the terminals.

Such resistance will be traversed by a current which, at every instant, will have an intensity defined by Ohm's law. This intensity will pass through zero or through a maximum at the same instant as the difference of potential, and there will be no *decalage* between the current and the difference of potential. The expenditure will be reduced to the heating of the conductor, in conformity with Joule's law.

If we replace this resistance by an electro-magnet bobbin, a transformer winding or an alternating current motor, the conditions will change. The iron core will become periodically magnetized and demagnetized, and the motor will produce effective power. In all cases there will result a counter-electromotive force which will have the effect of reducing the intensity to a value less than it would have if we were dealing with a simple resistance and of retarding the current with respect to the difference of potential by a fraction of a period variable with the nature of the circuit. It results from this that the current and the electromotive force no longer pass through zero at the same instants. The changes of sign of the power, therefore, render it alternatively positive and negative, that is to say, the electric energy set in play in the period is successively stored up during a certain fraction of the period in order to effect the magnetization of the core, and is afterward restored during another fraction of a period corresponding to the demagnetization. The real expenditure represents only the *difference* between the energy furnished and the energy restored during the period, and such difference is often only a very small fraction of the total energy set in play during the period.

In order to measure such difference, it was therefore necessary to devise a special apparatus to take into account the *decalage* that we have just indicated, and such apparatus is no other than the wattmeter, that it remains for us to describe, in taking for a type one of those most employed in the alternating current industry—that of Mr. Zipernowsky.

In principle the wattmeter is a tension electro-dynamometer, one of the bobbins of which (the fixed one) is traversed by the total current, while the other (the movable one) of fine wire, mounted in tension with a great resistance, is established in derivation between the two terminals of the apparatus utilized, whose mean power absorbed it is desired to measure. The movable bobbin revolves around a vertical axis and is fixed to a spiral torsion spring that permits of bringing it back to the same position at every measurement by twisting the spring in an opposite direction by an angle that may be measured upon a graduated limb fixed to the upper part of the apparatus. The fixed bobbin exerts upon the suspended movable bobbin a couple proportional at every instant to the product of the two intensities that traverse the bobbins. But the fixed bobbin is traversed by the current, and the movable bobbin, whose resistance is constant, is traversed (by virtue of Ohm's law) by a current proportional at every instant to the difference of potential existing between the terminals of the apparatus utilized. The couple, therefore, is at every instant proportional to the product of the intensity or difference of potential. It becomes null when one of the factors, intensity or difference of potential, becomes null, and has for mean value the mean of the values that the product takes during a complete period. In twisting the spring by a certain angle, and provided that such torsion remains within the limits of electricity of the spring (a condition always fulfilled in a well proportioned apparatus) and an angle such that the movable bobbin shall be brought back to its initial position of equilibrium before the passage of the current, we read upon the graduated limb angles proportional to the mean power absorbed by the utilized apparatus between the terminals of which it is branched.

We may vary the scale of the readings of a given wattmeter in large proportions by arranging two fixed bobbins, one for feeble intensities and the other for high ones, and in interposing a box of variable resistances in the circuit of the movable bobbin in order to cause such resistance to vary according to the difference of potential at one's disposal.

Thus, for example, with a wattmeter such as represented in the accompanying figure, it is easy to measure the mean power furnished to the primary circuit of a transformer by placing the bobbin for feeble intensity in the primary circuit and interposing all the resistances of the box in derivation between the terminals of the primary. In order to measure the effective power in the secondary, the current is made to pass into the coarse wire bobbin and the fine wire bobbin is established in derivation upon the terminals of the secondary in interposing a feeble resistance therein. It is thus possible with the same apparatus to measure 20,000 watts under the form of 2,000 volts and 10 amperes, or 100 volts and 200 amperes.

The wattmeter renders valuable services, not only for industrial measurements, but also in scientific researches. Mr. Steinmetz has recently utilized it for the determination of the losses of energy produced by the periodical magnetization of the iron in a transformer, and for the determination of magnetic constants.

The study of its applications and of the corrections that its use permits of in certain particular cases in which its introduction into the circuit modifies the nature of the electric circuit, does not come within our scope and would require a volume. It suffices for us to have pointed out the utility and the simplicity of this measuring apparatus, now an indispensable adjunct to all stations of distribution of electric energy by alternating currents.—*La Nature.*

THE EFFECT OF WATER VAPOR ON ELECTRICAL DISCHARGES.

A VERY interesting paper by Prof. J. J. Thomson, on the effects of electrification and chemical action on a steam jet, and of water vapor on the discharge of electricity through gases, appears in the October number of the *Philosophical Magazine.* In it the author first considers the effect of an electrical field on the surface tension of a water drop, and he shows that if the electrical field is uniform, the diminution in the surface tension is very small and independent of the size of the drop; so that a uniform field will not be able to counterbalance the effect of surface tension, since the latter varies inversely as the radius of the drop, and therefore when the drop is excessively small must be greater than the constant effect due to the electric field. When, however, the electric field instead of being uniform is due to a number of charged atoms distributed throughout the volume occupied by the steam, the effect of the electric field in diminishing the surface tension varies inversely as the square of the radius of the drop. Thus, for very small drops, the electrification will overpower the cause (surface tension), which, under ordinary circumstances, puts an end to the existence of small drops. The above seems capable of explaining the effects of electrification on a steam jet first observed by Helmholtz, for the electricity which escapes into the gas is carried by charged atoms of the gas, and since in the region immediately

around these atoms there will be a very intense electric field, there will be a tendency for the steam to condense into drops in these regions. Helmholtz also discovered that chemical action in the neighborhood of the jet affected it in much the same way as a discharge of electricity. If the forces which hold the atoms together in a molecule are electrical in their origin, so that in a diatomic molecule one atom has a positive and the other an equal negative charge, the above explanation will also apply to this case. For when the molecule of the gas is in the ordinary state, the equal and opposite charges of the atoms will, in the region outside the molecule, neutralize each other's effect, so that the electrical field round a molecule will be much less intense than that round a single-charged atom; and thus, though the field round the latter may be sufficient to cause condensation, that round the molecule may not. When, however, the molecules which enter into chemical combination come together and form a new compound, requiring a rearrangement of the atoms, then, while the chemical change is going on, there will be an interval during which the atoms are comparatively free, and there will be an electric field almost as strong as if the atom were dissociated.

The author also considers the effect of moisture in promoting chemical action, for if the forces which hold the atoms in the molecule together are electrical in their origin, it is evident that these forces will be very much diminished when the molecule is near the surface of, or surrounded by, a conductor or a substance like water having a high specific inductive capacity. Thus, if A and B represent two atoms in a molecule placed near a conducting sphere, then the effect of the electricity induced on the sphere by A will be represented by an opposite charge placed at the image of A in the sphere. If A is very near the sphere, this opposite charge will be very nearly equal to that at A. Thus the effect of the sphere will be to practically neutralize the electrical effects of A, and as one of these effects is to hold the atom B in combination, the affinity between the atoms A and B will be almost entirely annuled by the presence of the sphere. Molecules condensed on the surface of a drop of water or surrounded by water will thus be practically dissociated, or, at any rate, the forces between their component atoms will be much reduced. Since water vapor produces so great an effect on chemical combination, it is interesting to investigate whether its presence has any considerable influence on the passage of electricity through gases, since there is strong evidence that this phenomenon is closely connected with chemical changes taking place in the gas through which the discharge takes place. Observations were made on dry and damp hydrogen, and show that there is a marked difference, both in the appearance of the spark and in the proportion between the potential difference necessary to produce the first spark through the gas, and that which is sufficient to cause one to follow it immediately afterward. In the damp gas this difference was comparatively small, averaging about ten per cent. In the dry gas, however, this effect attains quite abnormal proportions, the potential difference required to produce the first spark being often more than twice that required to maintain it when once started. These experiments show that the behavior of a gas with reference to the passage of an electric spark is analogous to that of a vapor condensing to a liquid, the freezing of a liquid, or the deposition of crystals from a saturated solution. For in the case of a gas which contains a foreign substance (water vapor) the potential difference which the gas can support without a spark passing is approximately steady, but when the gas is carefully dried it can support an abnormally large potential difference, though when once the discharge has started the potential difference at once falls to its normal value. The passage of the spark produces a supply of modified gas which persists for some time after the discharge has stopped.—*Nature.*

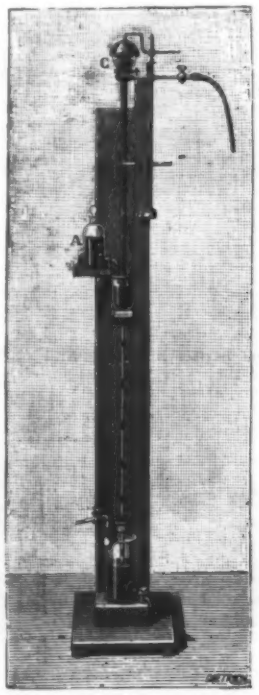
OXYGEN GAS AS AN ENRICHMENT FOR COAL GAS.

WE are indebted to *The Gas World* for the following particulars concerning a remarkable process, which is now being successfully worked, for very considerably increasing the illuminating power of coal gas, involving what at first sight would appear the highly dangerous operation of introducing into the gas a quantity of pure oxygen. In the year 1890 Mr. Edward Tatham, of New South Wales, made the bold proposal to add considerable quantities of pure oxygen to warm, heavy oil gas, with the object of producing a stable gas of very high illuminating power. Later in the same year Dr. L. T. Thorne communicated to the Gas Institute the results of preliminary experiments with this gas, which he had carried out on behalf of Brin's Oxygen Company. These experimental results led to the conclusion that rich oxy-oil gas *per se* was far and away more effective as an illuminant than the coal gas now employed for this purpose, but that its more immediate prospect of use lay in the direction of enhancing the lower illuminating power of ordinary coal gas. Preparations have since been made for practically testing the applicability of oxy-oil gas to the enrichment of coal gas, and the Hydro-Oxy Gas Patents Proprietary, Limited, have erected at 11 Salisbury Square, E. C., a complete experimental plant for the purpose. Moreover, the corporation of Huddersfield are erecting a plant for the purpose of enriching the coal gas supplied to the borough. The Huddersfield installation is not yet completed, but a portion of it is ready, and is now in actual operation. When complete it will consist of an oxygen plant and four bays of oil gas retorts, capable collectively of producing 200,000 cubic feet of oxy-oil gas per day, together with the necessary condensers and holders. The oxygen plant has been already erected by Brin's Oxygen Company, and is their newest type of producer. It is built in two sections, which may be worked together or independently, and will make no less than 30,000 cubic feet of oxygen per day. This, the largest oxygen producer ever constructed, is now in active operation. Of the oil gas plant one bay, consisting of fifteen cast iron retorts, is also working, and is capable of producing 50,000 cubic feet of oil gas per day. The lowest and hottest of the retorts are intended for "cracking" the residues from the upper retorts, but they may of course be fed with clean oil if required. The oxygen is introduced into the oil gas soon after the latter leaves the retorts and while still warm; the mixed gases then pass together through the condensers. The admission of the oxygen is automatically adjusted by means of a combination of meters, so that the proportion is constantly maintained at fifteen per cent. The oxy-oil gas is stored in special holders, and it is arranged to admit it into the coal gas just before the entry of the latter into the station meter, the quantity being regulated by a meter coupled to the station meter. The results so far attained are highly satisfactory. The admission of about six per cent. of oxy-oil gas is already found to increase the illuminating power of the corporation gas by the equivalent of five and a half candles, and this is probably much below the enrichment which will eventually be attained when the plant is complete, and when normal coal can again be employed at the cessation of the strike. The results attained by the Salisbury Square plant are considerably superior to this, and it is expected that the Huddersfield installation will eventually attain the same standard. Further, a marked increase in the stability of the gas is observed, for poor coal gas actually loses more illuminating power by storage than the same gas admixed with oxy-oil gas does. As regards cost, it is calculated from the experimental data furnished by the working portion of the Huddersfield installation that the increased cost of production of the gas so enriched will not, at the highest estimate, exceed a third of a penny per thousand cubic feet.

LABORATORY APPARATUS FOR THE DISTILLATION OF MERCURY.

IN laboratories there is often need of pure mercury for filling barometers or thermometers or for the construction of standards of electric resistance, etc. It is necessary that the mercury shall be free from all impurities. A preliminary clearing may be effected simply by means of a flagon provided at the bottom with a glass cock. The dust remains on the surface and only the metallic portion is drawn off.

In his admirable researches upon equivalents, Stas



APPARATUS FOR DISTILLING MERCURY.

treated the mass with nitric acid so as to convert about a tenth of the whole into nitrate. The metals more oxidizable than the mercury were certainly found in this first tenth that was separated. The attack was afterward continued so as to leave a residue of one-tenth, which contained all the slightly oxidizable metals. Pure mercury was then obtained through a reduction of the nitrate. This process is, unfortunately, very costly and requires much labor. In laboratory practice the operator contents himself with the first part of the method, that is to say, the mercury is attacked with nitric acid, so as to remove all the easily oxidizable metals. Drying is afterward effected through sulphuric acid and fused potassa. But if the mercury contains gold or platinum, it carries them along, and it is through distillation that these metals are separated with the greatest facility. This process, much employed abroad, is little known in France, for the want, perhaps, of a practical apparatus. This want has just been supplied in an instrument constructed according to directions by Mr. Gouy. The apparatus in question much resembles that of Mr. Mendeleef, but differs therefrom in quite an important improvement. The mercury of the flagon, A, is drawn off, as wanted, into the reservoir, B, into which enters the neck of a balloon, C, that serves as an alembic. At the upper part of the balloon there debouches a glass tube of a constant diameter for a certain length, and that terminates in a capillary part about 3 ft. in length. This latter engages in a flagon hermetically closed, and that can be put in communication with a pneumatic machine. When the vacuum is sufficient, the mercury ascends into the balloon, which it half fills. Upon heating with gas jets the mercury is made to enter into ebullition. The vapors condense in the descending tube and form in falling large drops, which enter the capillary tube in inclosing a small space that they thrust downward. In this way, the traces of gas that may remain in the apparatus are carried outside and a vacuum is maintained indefinitely—an indispensable condition, if it is desired to avoid the oxidation of the mercury.—*La Nature.*

[Continued from SUPPLEMENT, No. 932, page 14901.]

PILOCARPINE: ITS PHYSIOLOGICAL ACTION AND THERAPEUTIC USES. WITH EXHIBITION OF SPECIMENS SHOWING CHANGE IN THE COLOR OF THE HAIR.*

By D. W. PRENTISS, M.D., Washington, D. C.

GENERAL DISEASES IN WHICH PILOCARPINE IS USEFUL.

1. *Dropsies.*
   - Of renal origin.
   - Of cardiac origin.
   - Local dropsies—*e. g.*, hydrothorax.
   - Hydropericardium and ascites.
2. *Uræmia.*
   - Anuria from various causes.
   - In Bright's disease.
   - Puerperal convulsions.
3. *Diseases of the skin.*
   - Especially such as are attended by dry, itching skin.
   - Prurigo, pruritus senilis.
   - Chronic urticaria, chronic eczema.
4. *Diphtheria.*
5. *Diabetes insipidus.*
6. *Galactagogue.*
7. *To stimulate the growth of the hair.*
8. *As an antidote to serpent venom.*

1. *In dropsies* its value is evident from the amount of liquid excreted from the system.

In renal dropsy and in local dropsy, such as hydrothorax, its value is particularly marked.

In renal dropsy it relieves not only by taking water out of the system, thus causing its absorption, but also by the large excretion of urea it causes, thus relieving the uræmia, as in the case before quoted. Another effect, especially in acute nephritis, is to relieve congestion of the kidneys and restore them to action.

It is desirable in administering the drug to wrap the patient in blankets and surround him with hot bottles, to increase the diaphoresis, and if he is exhausted, give a stimulant.

In hydrothorax, hydropericardium, and ascites the same method is to be employed. In the former the results have been especially satisfactory. In dropsies due to heart disease, special care must be taken to guard against the depressing action.

2. *Uræmia.*—Enough has already been said of its use in uræmia due to *anuria*, in the case quoted, to indicate its usefulness. In puerperal convulsions it has proved of great value.

3. *In diseases of the skin*, particularly those attended by itching and in which the skin is dry.

In one of the cases where it caused change of the color of the hair it was given successfully for the itching attending chronic Bright's disease, in dose of 20 to 30 drops of the fluid extract several times daily for a year and a half.

It caused moisture of the skin and relieved the itching.

I have seen it give prompt relief in a case of obstinate urticaria after the usual remedies had failed. In this latter case there was a gouty rheumatic affection of the finger joints, which disappeared while under its use.

In another case of rheumatic gout of the fingers it was given successfully. So, also, in subacute and chronic rheumatism of other joints that resist ordinary treatment, pilocarpine is worth a trial on the basis of aiding the excretion of effete material from the system.

In these cases it is given by the mouth, either in form of the fluid extract or of the alkaloid, just sufficient to cause moisture of the skin and slightly increased flow of saliva, and must be continued sufficiently long to get decided excretory action.

4. *In Diphtheria.*—Dr. Guttman, of Cronstadt, was the first to insist on the value of pilocarpine in this disease, and he claimed favorable results in a large number of cases. His observation was, not that it exerted any specific action in the disease, but that it loosened and softened the false membrane by its action on the mucous membrane beneath, so that the former was easily expelled.

Following his report, Lax reported ten cases treated by pilocarpine alone, all of which recovered.

Later, Dr. E. C. Wendt (*Med. Record*, April 9, 1881) reported three cases which recovered under pilocarpine after other remedies had failed. On the other hand, Neumeister published twenty-eight cases thus treated, with unfavorable results. Five cases were adults, twenty-three children.

The adults appeared to be influenced favorably, but with the children, thirteen out of the twenty-three died, and in eight bad effects of the drug were observed.

Neumeister's conclusion was that pilocarpine is a dangerous drug with children, and that its value in diphtheria is not sufficient to justify its use.

In a disease so fatal as diphtheria, especially the laryngeal form, any remedy which promises to avert the usual termination is welcomed with avidity.

The following case illustrates the most favorable action of the remedy in this disease. It occurred in my practice shortly after Guttman published his cases.

I give only a synopsis of the case. Charles S., aged fourteen months, strong, healthy child of German parentage, had been ailing for several days previous to July 9, 1881, with hoarse cough. On this date I saw him, when voice was lost and he was restless.

July 10.—Breathing loudly stridulous; voice entirely suppressed; entire fauces were covered with ashy-white membrane.

July 11, A. M.—Worse; dyspnœa and restlessness increased. Pilocarpine, 2 milligrammes, ordered to be given every hour, milk punch *ad lib.*

July 11, P. M.—No worse.

July 12, A. M.—No worse; turpeth mineral emetic given during night; dose of pilocarpine doubled.

July 12, P. M.—Better; slept most of the day; stridulous breathing less marked; more cough and cough looser; sweating and salivation very free; dose of pilocarpine reduced to original amount.

July 13, A. M.—Still better; passed comfortable night, sleeping; stridulous breathing gone; false membrane has disappeared from the fauces.

July 13, P. M.—Still improving; cough troublesome, but loose; aphonia still present.

* Read before the New York Academy of Medicine by invitation, April 5, 1883.—*Therapeutic Gazette.*

July 15.—Still improving; slight return of voice; some appetite.

July 18.—Diphtheria well; slight diarrhœa.

When I first saw this case I considered it hopeless in the light of previous experience. It illustrates the most favorable action of pilocarpine in diphtheria.

I have tried it in many cases since, but without so favorable a result.

The form of diphtheria in which pilocarpine is most useful is that known as membranous croup, in which the danger is from the local obstruction to respiration rather than from septic infection and exhaustion. In these cases it favors the separation of the membrane and consequent expulsion.

5. *Diabetes Insipidus.*—In this disease it acts as a revulsive by attracting away from the kidneys the excessive secretion of water and directing it to the skin and salivary glands; and the habit once broken, it may not return.

One case under my observation, a German blacksmith, aged about fifty years, had a sunstroke in July, which was followed in October by diabetes insipidus.

The amount of urine passed was very great, a large bucket being filled during the night and as much more passed during the day—about four gallons in twenty-four hours.

The amount of water drank was in proportion. The skin was dry and scaly, though in health he had always sweated freely.

After trying other remedies without relief, he was ordered 4 grammes of the powdered leaves in infusion, the powder to be stirred up and drank with the infusion at bedtime; at the same time the man was wrapped in hot blankets.

The following morning I found him much exhausted, unable to rise from weakness. He had sweated and salivated all night. The blankets were soaked, the mattress soaked, and there was a puddle of water on the floor under the bed. But it was the end of the polyuria, the latter never returned.

This case occurred over twenty years ago. There has been no return of the disease, and the man is still in good health for his age.

6. *As a Galactagogue.*—Its action upon the mammary gland is analogous to its action upon the salivary and sweat glands, but in a much less degree.

Many cases have been reported of its successful use when there was insufficient secretion of milk.

For this purpose it is administered internally in doses just sufficient to produce its physiological action without excessive sweating and salivation.

7. *To Stimulate the Growth of the Hair.*—This it does by increasing its nutrition through the hair bulb. There are two methods of administration for this purpose—one the slow method, by small doses given by the stomach through a long period in just sufficient amount to cause light sweating and salivation; the other, the rapid method by hypodermic injections of one centigramme two or three times a week. (See reports by Schmitz, Scholler, Simon, and Pick, farther on in this paper.)

8. *The Action of Pilocarpus as an Antidote to Serpent Venom.*—For the knowledge of this property of the drug we are indebted to Dr. H. C. Yarrow, of Washington, D. C., and late herpetologist to the United States National Museum.

The following letter from Dr. Yarrow explains itself:

"MY DEAR DR. PRENTISS: In answer to your inquiry as to the influence of extract of jaborandi as an antidote to serpent venom, I will state that my experiments at the United States National Museum, at Washington, D. C., upon the venom of the rattlesnake, led me to believe that jaborandi has decided antidotal value, and its active principle, pilocarpine, doubtless would be even more efficacious. These experiments were carefully made upon dogs, rabbits, and chickens, and it was conclusively shown that jaborandi, administered hypodermically after the application of the venom, protected against an otherwise lethal dose. So, also, did the administration of the drug internally immediately after the poisoning. The details of these experiments were published in *Forest and Stream* for the year 1888.

"Very sincerely yours,
"H. C. YARROW, M.D."

ACTION ON THE EYE.

Brunton divides myotics (pupil con.ractors) into two classes:

1. Those which act by stimulating the endings of the oculo-motor nerve, which supply the circular fibers of the iris—viz., pilocarpine, muscarine, nicotine.

2. Those which act directly on the circular fibers themselves—viz., eserine.

Pilocarpine contracts pupil and causes spasm of accommodation by stimulating the oculo-motor nerve endings of circular fibers of the iris, and those to the ciliary muscle.

Action upon accommodation begins after, and passes away before, that upon the iris. The effect on the eye, when applied locally, lasts about one hour and a half.

Atropine, on the contrary, dilates the pupil and paralyzes the accommodation by paralyzing nerve endings of the oculo-motor, and stimulating the radiating fibers of the iris.

The importance of these physiological actions is in their relation to intraocular pressure.

I hope I may be pardoned a reference to the therapeutics of certain eye diseases in this presence, where so many are already familiar with the subject in their daily work. But all of us are not specialists, and the reference is in the line of *pilocarpine.*

Intraocular pressure is increased by the increase of fluid in the anterior chamber. As,

1. An increase in the amount secreted by the ciliary processes (aquus capsulitis).

2. Interference with its exit through the canal of Schlemm into the perichoroidal spaces (glaucoma).

3. Hyperæmia of the iris.

Intraocular pressure is diminished by opposite causes. Pilocarpine and eserine diminish intraocular pressure by drawing backward and flattening the iris, so as to allow the fluid of the anterior chamber to escape through the spaces of Fontana and the canal of Schlemm into the perichoroidal spaces.

The diseases of the eye in which pilocarpine and other myotics are useful I will merely enumerate:

DISEASES OF EYE AND EAR IN WHICH PILOCARPINE IS USEFUL.

Diseases of Eye.	Glaucoma. Hemorrhage into vitreous and retina. Detachment of retina. Floating bodies in vitreous. Vitreous opacities. Commencing atrophy of optic nerve. White atrophy (a specific, according to Gillet de Grandmont). Paralysis of accommodation. Amblyopia from tobacco or alcohol poisoning (*par excellence*). Chronic rheumatic affections of eyeball. Photophobia. To break up adhesions of iris to lens or cornea.
Diseases of Ear.	Labyrinthine deafness. Aural vertigo.

I have mentioned *glaucoma* first because it is a matter of so much importance to the general practitioner that he should be able to recognize it, and at least do no harm if a case comes to him.

The majority of cases of glaucoma come first to the general practitioner, and the two symptoms—hardness of the eyeball and rainbow colors around a light—should put him on his guard. If these symptoms are present, with dimness of vision and pain, better send the case to a specialist.

But, of all things, do not put *atropine* in the eye. This last, unfortunately, is too often done, the case being mistaken for iritis, the result of which it is unnecessary to state to this audience.

In all of these diseases the pilocarpine is useful, from one or all of its properties, in (1) reducing intraocular pressure, or (2) contracting the pupils, or (3) stimulating the muscle of accommodation.

In commencing atrophy of the optic nerve according to Gillet de Grandmont, it is almost a specific (Brunton's "Therapeutics").

In amblyopia from tobacco and alcohol also it is credited with being a most valuable remedy.

When used only to contract the pupil and stimulate accommodation, it may be dropped into the eye in solution.

But when used in the graver internal diseases of the eye, it must be pushed to its full physiological action, and had best be administered hypodermically in dose of 1 centigramme, this being given once daily, or once in two or three days, according to the effect.

In labyrinthine deafness and aural vertigo, success has been claimed in several cases. It is administered as above. He does not explain the manner in which it acts.

ANTAGONISM BETWEEN PILOCARPINE AND ATROPINE.

This is so well known that it needs but to be mentioned.

Pilocarpine causes sweating and salivation and increases secretion of mucous membranes; contracts pupil and stimulates accommodation; diminishes intraocular pressure.

Atropine and *jaborine* are the opposite in every particular.

The two are, therefore, physiological antidotes of each other.

A pilocarpine sweat can be stopped by a hypodermic injection of atropine. In experiments on frogs, where the action of the heart has been stopped by pilocarpine, it can be restored by atropine.

So, also, poisoning by belladonna, stramonium, or hyoscyamus can be, and has been, successfully treated by pilocarpine. Such cases have been mentioned by several writers.

A case is reported in the *Australia Medical Gazette* (February 15, 1892, by Dr. Cortis) of a child, eighteen months old, who took four grains of sulphate of atropine and six grains of cocaine. Pilocarpine, one seventh of a grain, was injected, and shortly after repeated. There was immediate improvement and prompt recovery.

The amount required to antagonize a given dose of atropine is stated to be four times as much of pilocarpine.

In the three following respects pilocarpine and atropine agree in action:

1. In producing frontal pain.
2. In producing pain in bladder.
3. In affecting children less than adults in proportion.

But these have no importance from a therapeutic standpoint.

(To be continued.)

THERAPEUTICAL SUPERSTITION.*

By GEORGE T. WELCH, M.D., Passaic, N. J.

RECENT researches into obsolete medical works have convinced me that an old scientific book is not more valuable in any other way than it is in what it represents as a landmark of the attainment of thought and speculation up to the very hour that it issued from the press. Truth changes its aspect; what we have thought was an eternal principle was some issue caught motionless at a turn of the tide. When we have believed penetration could go no further, some fresher genius has taken the trail and disappeared, after shining for a moment upon a further upland.

The Romans erected arches to victory, and columns in remote provinces to mark their ever-widening boundaries. Beyond many of these flowed the human tide, rising in continued swells of grandeur to this hour; but some of them are to be found by chance travelers, in deserts, and some have mouldered quite away in vast solitudes. And just as these ancient and daring conquerors marked their latest triumphs with monumental shafts and sculpture, on which were graven battles and the names of heroes, so, in our books, the great teachers and historians of our art have celebrated the achievements of the profession and recorded the long roll of illustrious physicians. Some of these books, even so far back as the famous one of Hippocrates, have been guides to posterity, while others have been shunned as pointing the way to haunts of superstition and morasses of the human mind.

We smile superiorly when we look at some of them and perceive how very little had been wrested from ignorance and credulity, while the book itself is so pretentious. And yet every recruit, every appliance of skill, wisdom of the fathers, resource of the sons, drift of theories, fragments of tradition, charms even, and necromancy, all that was believed and all that was hoped, were brought together under the standard that was borne thus far into the wilderness—the Scythia that besets us with difficulties, and every morning presents a further horizon. And the latest book has brought all up to date, and with an unremitting courage the author has placed another shaft to victory, which we begin already to leave a day's journey behind us.

Nothing is established, nothing is sure, is a hopeless cry sometimes heard, but, like the Roman, we leave a regent in every conquered province, where, if the court shifts and the elements revolve, we still govern upon principles that defend us. Nor have we any reason to feel the superiority of any other profession above our own when we reflect that all alike are humbled before vast problems, and either feel their way with caution or are rebuked by the judgment of posterity. The austere creeds of the theologian are constantly crumbling. That which must be defended is no longer impregnable. Divinity is breaking into a thousand sects. The ameliorating, humanizing principle is abroad. Some of the weaker minds, not daring to try the issue, are for leading their flocks back into the old paths. They spurn their natural leaders and contemn them as outlaws, while with vestments and rituals they seek to lull the human mind. They had as well seek to bind the floods with cassock bands, and seal the cave of the winds with threats and excommunication.

Should we turn to statesmanship, we find armed neutrality. The invention is sterile that dares not dare. And yet, empires are but maps of an hour. Slight incursions change boundaries. In law we approach the exasperation of politics. It is always changing and never satisfactory. It is a net that draws hard upon the petty criminal, but bursts when a corporation is entangled. Descartes found a whole library in the human body, but your lawyer, confronted with a perplexing cause, goes to a myriad of books to find his clews. We fret and repine because every physician that prescribes for an ailment is not a trained scholar in his profession, and we fulminate about it so much that, mistaking our conscientious care for an admission, the other professions smirk and grimace, but the egotist with the longest purse goes to the senate and the ruffian with the greatest saloon interest becomes the lawmaker for a State. In the cabinet there is vacillation, in the senate great measures stagnate, in the legislature partisanship predominates. Smirk hirelings climb the pulpit—"the hungry sheep look up and are not fed." In the natural sciences the savants are still classifying. The astronomer is not sure that his burned-out suns may not be stars about to germinate.

In the face of all this dilettantism, what reason have we to stand at bay? We have gone far and have established much. No one will deny the potency of Jenner's vaccine, or Lister's antiseptic methods, and all that goes under the comprehensive title of hygiene. The study of preventable causes of disease is raising the standard of medicine, and just as physicians recognize that their mission is a wider one than the mere administering of drugs to cure the ill, will they exalt their profession and become an established power in government; for if we exclude from the human family all the preventable diseases, and those produced by worry and mental strain, by physical strain, the excesses of the passions, by alcohol, tobacco, narcotics, unwholesome foods, impure air, by occupation, sloth and idleness, late hours and broken sleep, error of dress, imitation and moral contagion, automatic diseases and hypochondriasis—all of which are evils that can be avoided—how small a percentage would be left for the doubtful compounds of the pharmacopœia. "If intermarriage of diseases were considered in the same light as intermarriage of poverty, hereditary transmission of disease, the basis of so much misery in the world, would be at an end in three or four generations."—*Richardson.* There will come a day early in the next century when a secretary of health will be as necessary a member of the cabinet as he who holds the portfolio of law or agriculture.

That this has not been so long ago in all countries is not so much the fault of a progressive profession as it is of a vicious education in therapeutics. However man may deteriorate his health, however long he may have put at defiance every law of nature, he demands an instant cure. He may scoff at miracles elsewhere in the natural world, but he confidently expects one at the hands of his physician at any hour, let the disease be what it may. And the physicians are few who boldly stem this senseless tide. The majority yield to it; go with the current, pander the superstition. Vainly they offer this or that panacea, and painfully reminded by past experience that the discouraged patient may suddenly leave and go to the coast of some other Bohemia, they make a dizzy change from drug to drug, but the demon of disease looks out and leers at them. He will not be propitiated or poisoned in his keep.

To have perfection in the child, says Holmes, we must begin with his grandfather, and in morals no man expects that a clergyman hastily called in will by some hocus pocus make saint of one who, long a sinner, has at length committed some atrocious crime. The mills of the gods grind slowly—and human laws are inexorable too. The transgressor finds to his cost that he must endure many fluctuations of hope, many fines and penalties, for the delays of the law are proverbial. There are, it is true, many ephemeral laws, such as have scourged us at Trenton since booted and spurred the jockeys have ridden the State till the galled jade winces, but the Supreme Court has remedied these right speedily, and so there are ephemeral diseases that Nature will right and which must succumb of themselves. And without cavil it is in the

* Address of the president, read before the New Jersey State Medical Society, at its meeting at Asbury Park, in June, 1893. From the transactions of the society.

self-limited diseases that the incessant therapeutist has won his most signal triumphs. Like the fox in the fable, he has a thousand tricks by which he can baffle the acute assaults of la grippe, pleuritis, bronchitis, asthma, pertussis, endocarditis, dysentery, chorea, rubeola, dengue and acute rheumatism, for these are diseases whose tendency is to recovery. But he is less brilliant when pitted against croupous pneumonia, laryngitis, croup, œdema of the glottis, angina pectoris, acute gastritis, cholera, peritonitis, hepatitis, apoplexy, meningitis, tetanus, typhus fever, yellow fever, smallpox and diphtheria, for these are dangerous diseases.

He is restless and feels the prescience of defeat, though still dosing the adversary largely, when it comes to a conflict with the chronic diseases, such as general paralysis, paralysis agitans, phthisis, epilepsy, progressive locomotor ataxia and Bright's disease. He is obliged to sit down to a regular siege before all the diseases which, though acute at first, have become chronic in spite of all his drugs. For disasters like these he has numberless excuses—as that the patient was already debilitated, he contracted a cold, there were complications, an unmanageable diathesis was awakened. And then come the incurable diseases, such as gastric ulcer, carcinoma, cirrhosis of the liver, acute atrophy of the liver, and chronic diffuse nephritis. In the presence of these the most inveterate dispenser of drugs, seeing the death warrant, patent to all eyes but his who must suffer and endure, must stand humbled amid his pots and vials. He must, else, pour his libations in vain.

And is it not singular that drugs should be esteemed so powerful in the acute, self-limited diseases, and yet in the chronic types, where the opportunities for their potency is so prolonged, they should fail so signally?

As knowledge accumulates, this or that drug of the fathers, which was wont to be so irresistible in fevers, in imposthumes, or what not, is laid upon the shelf. We now know and can demonstrate that it was utterly useless, and yet the patient often got well! Every physician who has been spared to a great age can look back upon pharmacies ever changing. On the Ariel wings of memory he can glance into a thousand sick rooms and sniff the odors of drugs no longer known. They had their day and the fashion changed.

Men couldn't be soundly cured without calomel, once, and veratrum viride was a later triumph. Cod liver oil was once the Utopian remedy for phthisis. And it is astonishing how even an enthusiastic therapeutist can always find the improvement his horoscope has forecast. But in fact he is only the antipode of the specialist who is never known to examine a subject who has not something wrong in his line of business. Dr. Wood, in the fourth edition of his "Practice of Medicine," 1855, gives what may be taken as the average view of the physicians of the day in regard to the benefits of cod liver oil in phthisis, for the old professor was never rash, but we shall find that his opinion was tinted by the prevailing sentiment. "It does not act as a specific," says he, "and is wholly incapable of producing, by any direct influence of its own, the removal of the deposited tuberculous matter. But it invigorates digestion, improves the character of the blood, and by a peculiar power modifies the nutritive process so as to obviate in a greater or less degree the tendency to the deposition of tuberculous matter."

Now I question whether it is the experience of any scrutinizing physician to-day that cod liver oil invigorates the digestion; if it did, it would be the remedy par excellence, for the natural history of the disease in question shows that the fatal result is at length brought about by the gradual undermining and impairment of the appetite and digestion, which, once destroyed, the whole fabric collapses. And of all animal substances given to a healthy man, we shall find the ingestion of fats furnishes the most serious problem for the functional processes of the stomach and intestines. Now, long before J. Hughes Bennett voiced the popular impression that the origin of phthisis is due to defective fat digestion, it was the unwritten law that strumous indigestion and the indigestion of fats were synonymous terms. And not even a knight errant in medicine would now deny the connection of the indigestion of fats with the strumous diathesis. The healthy stomach that has not been appaled by sweets and sours, and fats and leans, hot fluids and ices, dry wines and sparkling, and all the menu of a modern dinner of state, may also digest cod liver oil mixed with ordinary food, but if more than a moderate amount is added, the digestion becomes deranged with all the hideous symptoms dyspeptics are so fond of confiding. What then of the stomach already far gone? Would you load a staggering porter with a few pounds more every time he faltered past you, on the theory that it would improve his strength?

When I was a student in the university and hospitals in Philadelphia, solutions and sirups of bromide of potassium were the popular tipple for all sorts of diseases, and quinine became the universal panacea for the laity just as it was losing ground with the profession, but the coal tar derivatives are pushing all others to the wall. The chemists would seem to have gone mad in their laboratories and to have applied the match to a new system of fireworks, so bewildering are their nimble coruscations of saccharine, pyrodin, hydroxylamine, methacetin, thalin, and exalgin. But the sparks die out as suddenly as they astonished, and many of them are already forgotten.

When it comes to this, that most of the self-limited diseases will get well without drugs, that some of the acute diseases with unfavorable complications got well in the previous generation and in the centuries gone, under the prescription of drugs now known either to have been inert or misapplied, and when we recognize the fact that, within five years, the medical journals teemed with encomiums of new drugs which are already superseded by others, which in their turn are getting a little *passé*, the confused physician may well exclaim with the dazed political vivant: "Where am I at?" He might feel his faith seriously shaken when he recalled how sadly he had been duped by the old pharmacologists and the organic chemists of the hour.

When we regard the fact that the earth everywhere, unless depopulated by merciless greed, is teeming with animal life in the highest state of perfection, which has been evolved from parent to parent through unmeasured æons, and that in his savage state man himself, until corrupted by his civilized congener, has been found to be of fascinating feature and vigor, we must admit that drugs have not been necessary to perpetuate and strengthen the races. And when we reflect that, though the complex forces of civilization have induced a variety of diseases, many of them are preventable and many of them self-limited, and therefore to be got rid of without drugs, and that the chronic forms of disease resist drugs, and that upon the whole the bills of mortality have not been lessened by them, we must conclude that our profession has given altogether too much prominence to the apothecaries' art and raised expectations in the minds of the ill which cannot be realized. Further, it has set upon them hordes of charlatans, which, like evil birds, batten upon human miseries. It is time that we should reform ourselves and convince the public that there are higher potencies than the therapeutical superstitions that we have dealt out to them. We detest and execrate the priesthood for driving a shrewd trade with the bones and relics and other useless lumber of the saints, but we have unconsciously set up a barter of a like kind, and need to have our temple scourged of the money changers too.

I am aware that it will be urged that the average physician of to-day is much more wary in the use of drugs, and that upon the whole smaller doses prevail and greater discrimination is exercised. I have heard, too, that the world has grown better, wars less numerous, man more concerned in raising his neighbor than in raising himself on his neighbor. But I note that the sentinels of old empires grimly regard each other across the borders; that Justice in the South is not only blindfolded, but has her hands tied willingly behind her back; that the saloon domineers our politics, that the shadow of the prison falls across the threshhold of the temple. And I know that in 1889 there were imported into this country $13,186,290 worth of drugs used in medicine, and that the succeeding years have not shown a less amount. I know, too, that there has been no inverse ratio existing between the pharmacies and the physicians. In an essay on this topic in 1889 I showed from the statistics of commerce and navigation of the United States for the year ending June 30, the gross amount in pounds of the chief drugs used in practice which were imported to that date. I have just received from the Secretary of the Treasury the volume containing the statistics of the importations for the year ending June 30, 1892, and I find the following startling items:

Quinia sulph.	2,686,677 ounces.
Cantharadies	10,446 pounds.
Balsam copaiva	206,011 "
Aloes	255,394 "
Asafetida	125,557 "
Ipecac	38,329 "
Jalap	112,601 "
Manna	49,335 "
Ergot	125,148 "
Cubebs	115,974 "
Nux vomica	1,392,437 "
Opium (9 per cent. morphia)	587,121 "
Rhubarb	118,874 "
Salacine	5,152 "
Morphia and all salts thereof.	42,391 ounces.
Calomel and other mercurial medical preparations	12,630 pounds.
Alkaloids and alkalies to the amount worth	$827,230

Certainly, no one can complain that there will not be enough to go round! Every mail is turgid with the pleas of manufacturing druggists. Our daily papers and the religious weeklies are insidiously padded with the advertisements of cure-alls. Postal cards, like so many tormenting gad flies, are pestering the sixty-odd thousand physicians of America with the information that this or that compound is the only safe remedy for lung, kidney or brain diseases. And these drugs do not pass into innocuous desuetude—they are used somewhere. Whoever has had the curiosity to read the minor medical journals that he might know what is going on in the under world must have been struck with the therapeutic greed of the writers—practical fellows who go scrambling crabwise over pathology to seize proprietary mixtures which are labeled to cure all the ills under the evil planets. The quacks grown wary, having been beaten off the field by the tremendous re-enforcements in the medical ranks, return to vend their wares to the physicians themselves.

I have searched a large number of the pamphlets and medical journals of all classes during the past three months, so that I might note the therapeutical extremes in this quarter of the latest year of the closing century. Brown-Sequard and his disciples are patiently engaged in the injections of organic liquids. He is not rejuvenating octogenarians with spermatin so frequently and successfully as at the first blush, in 1889, but he records here and there in a dreary waste of experiments that extract of the thyroid gland injected into somebody with myxœdema has metamorphosed the patient. Constantin Paul and Prof. Babes are transfusing extract of the gray matter for neurasthenia. Injections of the extract of pancreas are being tried for diabetes. In diseases of the heart, injections have been made with the extract of cardiac muscle. Dieulafoy has tried injections of extract of kidney on a man affected with uremia. Dr. Paul Gibier kindly announces, through a contributor in his own journal, that he has tried extract of cat muscle in cases of progressive muscular atrophy after failure with other methods, and gracefully adds that "he will probably report later on this subject." Dr. William H. Hammond, with fine insistence, appropriates all except the hint from Brown-Sequard of this fantastic pharmacology. He has made alkaloids of the different organs and portions of the ox, and proposes to do away with all other drugs and cure and renew like with like, giving an eye for an eye and a tooth for a tooth, like the Hebrews of old, while he opens up new fields to the apothecaries beyond the dreams of avarice. The medicine will come dear, but so all things do in art, and it is the simplicity and ready applicability of the remedies that must recommend them. Dr. Hammond questions whether among all the teeming brains that have swelled and broken on the shores of time, such a solution of the vexed question of therapeutics has ever presented itself, though dimly conscious that he may have heard of some old German who speculated on the probable results of giving a liver diet to men diseased in the liver.

(To be continued.)

WASHING OUT OF THE INTESTINAL TRACT.

By Professor ANTON VON GENERSICH.

DURING my study of the mechanism and capacity of the intestinal canal, undertaken for the purposes of a book I am shortly about to issue, I verified by experiment the possibility of a complete irrigation of the tract, and I consider that this operation may be of so high a practical importance to the profession that it ought not to be withheld to await the publication of the larger work. It is found that, if in the dead subject any kind of fluid is introduced through an irrigator into the upper end of the œsophagus, some three, four or possibly five liters will pass freely into the stomach and small intestines, but that pressure, even up to a point that causes rupture of the canal, will not compel any more fluid to enter. (This result is almost invariable in the adult corpse, although with children it does not hold good.) If an attempt, however, be made to pass the fluid upward from the rectum, it will be found that the universally accepted action of the ileo-cæcal valve does not occur, and that with a moderate pressure the fluid can be expelled from the mouth, having in its passage washed out the entire tract. The capacity of the intestinal canal, as I shall shortly show by the researches into the subject that I propose to publish, varies greatly in individuals, but for a full grown man the average is as follows: The large intestine will hold three liters, the small intestine about the same quantity, and the stomach and œsophagus about two liters, making the average total capacity about eight or nine liters; so that when nine liters of fluid have been admitted to the rectum through the irrigator the fluid begins to run out at the mouth. This process, which I propose to term "diaclysmos" (*διακλυζειν*), can be accomplished upon the living subject with care, and without any great difficulty or danger, and the question that I wish to bring forward is how far treatment in this manner of maladies depending upon the presence of a poison in the intestine may be feasible. Irrespective of the view which may be taken with regard to the true origin of cholera, it is pretty generally admitted that the poison enters the system by the intestinal canal and is diffused thence; and there is no doubt that the *materies peccans* has not as yet been favorably influenced by any remedy introduced by the mouth. Under these circumstances it has seemed to me that it would be a proper proceeding to try the effect of complete irrigation of the intestinal canal from below upward in certain cases of cholera, and the few experiments which I have made, in conjunction with Drs. Meizner, Jr., and Erdodi, and M. Urbanetz, at the local fever hospitals have yielded good results. I say certain cases, for in the selection of the proper cases care will have to be displayed. Although no force is used, the remedy is an unpleasant one and not unattended by shock, so that it is not suitable for advanced cases or for the subjects of cardiac or pulmonary disease or arterial degeneration. Manifestly, also, the victims of obstructive growths or malignant or tuberculous stricture cannot be treated in this manner. In the cases alluded to, a solution of from 1 to 2 per cent. of tannin water at from 37° to 38° C. was gently driven into the rectum, the anus being held tightly round the tube of the irrigator. As the abdomen became swollen and tense, and also on account of the extreme discomfort of the patient, it became necessary now and again to cease injecting, but when six or seven liters had been taken in, vomiting occurred with much relief of the abdominal discomfort, and in this way as much as ten liters would be passed from the anus to the mouth. On the removal of the tube the fluid flowed out at the lower end, but about two or three liters remained in the intestines. No remedy that I have tried has resulted in such marked apparent improvement; for the patient, cold and collapsed before the operation, grows warmer during the injection and is left with a stronger pulse and all the general appearance of being better. The process may be repeated twice, thrice or more often. I do not lay any particular stress upon the use of a solution of tannin, and am of opinion that any non-poisonous saline solution would possibly yield as good results, but tannin is undoubtedly a harmless agent and both antiseptic and styptic.

I do not claim for this treatment that it will prevent mortality from cholera, particularly as it is clear that in many instances there will be circumstances precluding its use; but I believe that in many cases, both of cholera and of other forms of intestinal poisoning, the process may prove to be of service, and I hope that those of my colleagues who are in a position to make more extensive experiments will consider that irrigation is worthy of trial.—*The Lancet.*

TREATMENT OF SEA SICKNESS.

A CORRESPONDENT of the *British Medical Journal*, who has recently crossed the Atlantic, says: "A formula which has been much recommended by Dr. Charteris, of Glasgow, and which has well stood the test of Atlantic Ocean experience, is based on the combination of 20 gm. each of choralamide and bromide of potassium; both of them individually useful, but which seem to act better in combination, and may be flavored with licorice or tincture of orange peel. A 'specialty' has been made of this under a 'registered' trade title, I know not by whose authority or for whose benefit. A very effectual and pleasant form in which to administer this compound is as follows: Tinct. aurantii recentis, ʒ iv.; chloralamide, ʒ ij.; pot. bromidi, ʒ ij.; aquæ chloroform., ʒ ij.; aquæ dest., ad ℥ viij.; dose, ¼ part. Chloralamide is incompatible with alkalies, and is soluble in about 1 in 20 of water. This combination is particularly valuable in the frequent cases of sea sickness, with insomnia; it does not interfere with the digestion or temperature. Dr. Johnson, of the Cunard steamship Aurania, tells me that he has tried it extensively, and with excellent results. Where there is much pain as well as irritability, the sipping of ice water

is often very soothing; and it is here that cocaine tablets of $\frac{1}{30}$ or $\frac{1}{15}$ of a grain find their appropriate sphere of usefulness. They are usually prepared with chocolate, quickly eaten, and swallowed at intervals of half an hour or an hour. Where there is pallor, faintness, and more or less tendency to 'collapse,' as in some severe cases, very great relief may be found from the use of nitroglycerine tablets. The tablets have the nitroglycerine in solution in chocolate in a perfectly safe, stable, portable, and palatable form. Tablets of $\frac{1}{250}$ of a grain are a sufficient dose to ward off sea sickness. The small bulk, precise dose, and quick action, if well munched and swallowed, render this mode preferable for administering nitroglycerine."

EXPERIMENTS IN CHANGES OF COLOR WITH REAGENTS.

IN a large number of cases chemists who are making a quantitative analysis are apprised of the end of a reaction by a change of color, such change resulting from the natural affinities of the bodies in presence, or, what is more frequently the case, being due to a colored reagent introduced as an auxiliary.

Such changes of color give rise to a large number of interesting experiments, a few of which we shall describe.

The Magic Glass of Water.—Put a pinch of finely ground and sifted red sanders in a glass of water, and the liquid will at once assume a red color similar to that of claret. If this liquid be poured into another glass, previously rinsed with a few drops of vinegar, it will assume a beautiful tint, resembling that of brandy. If a little potassa be added to it, it will change back to its original color, and, finally, if a little alum be introduced, it will become as black as ink; so that, to a person not in the secret, it would seem as if claret, brandy, and ink had been obtained from a simple glass of water.

Water Changed into Wine.—Place in a glass a solution of sulphocyanide of potassium or of ammonium. This solution (which is very poisonous) will appear as limpid as water. Pour the liquid into another glass, in the bottom of which has been placed a minute quantity of sulphate of peroxide of iron, and it will at once change to a red color. The sulphate of peroxide of iron may be obtained by pulverizing some copperas and exposing it to the air.

Wine Changed into Water.—Dissolve 15 grains of permanganate of potash in a quart of water, and a liquid will be obtained resembling claret in color. Add to this solution 45 grains of tartaric acid.

Put into a bottle a few crystals of hyposulphite of soda and a little water and rinse a glass with the solution. If the permanganate solution be now poured into the glass, it will be instantaneously decolorized.

Wine Changed into Milk.—If vinegar be added to tincture of iodine, a beautiful red liquid resembling claret in appearance will be obtained. If into this we pour a solution of hyposulphite of soda, we shall obtain a milky white liquid (due to the deposition of sulphur), and a credulous spectator might be led to believe that wine had really been changed into milk.

Water and Wine from the Same Pitcher.—Prepare some water chemically by adding to each pint 40 drops of chloride of iron and a few drops of sulphuric acid. The glasses in which it is desired to have the wine-colored liquid appear are then prepared by rinsing them with a solution made in the proportion of one drachm of sulphocyanide of ammonium and one drop of a solution of nutgall in alcohol. One drop of this in each glass is sufficient. When the prepared water is poured into these glasses, it is instantly changed to a wine color. This may be changed back to water color again by the addition of a solution of acetate of lead. The instantaneous changes produced seem magical.

A Purple, Green, and Red Liquid from the Same Bottle.—Boil some leaves of red cabbage, and after half an hour's ebullition we shall have a beautiful purple liquid, which, when cold, may be put into a bottle for future use. Take three glasses. Let one be perfectly clean, in the second put a drop of ammonia, and in the third a drop of sulphuric acid. The liquid poured into the clean glass will, of course, preserve its original color, that in the second will turn green, and that in the third will become red.

If the odor of cabbage is disagreeable, the flowers of mallows, dark colored hollyhocks, or red pelargoniums may be used.

Colors Assumed by Flowers under the Action of Acids and Bases.—Through a series of very elegant experiments, Messrs. Filhol and Gaston Tissandier have shown that a large number of violet or rose-colored flowers immersed in ether to which a little ammonia has been added become a very beautiful green. Such are the rose geranium, the violet periwinkle, red roses, the heliotrope, etc. The action is the same with reddish colored leaves, such as those of the purple beech, for example.

Submitted to the action of the same liquid, white flowers become yellow, while yellow flowers, on the contrary, generally retain their color. With flowers of a non-uniform color, the results are still more curious. Thus, the upper petals of the violet sweet pea turn dark blue, while the lower assume a bright green color. The white extremity of the dielytra becomes yellow and the external petals metallic gray. If we simply expose slightly moist flowers to the vapor of ammonia, as has been done by Mr. Gabba, the results are the same, but it takes longer for the action to occur.

The coloring matter of these flowers is not destroyed, for if, after treating them with ammonia, they be immersed in pure water, they will resume their tints in a few days.

On another hand, these flowers submitted to acid vapors (to the vapor of hydrochloric acid, for example) become in a few hours a beautiful carmine red, which they preserve when they are put in a dry place and in the shade, after they have been dried in the air and in darkness.

Immersed in a dilute solution of potassa or soda, the same flowers give colorations analogous to those that they take on under the action of ammonia, but they come out of the solution deteriorated. The color first taken by the flowers is blue, and does not become green until some little time afterward.

Colored hollyhocks, the white and red pelargoniums and the corn poppy become blue and then green when they are immersed in a basic liquid, and assume a bright red color under the action of powerful acids.

A NEW REFRACTOMETER.

IN these times of continual falsification of food products and other substances, laboratories cannot be too well provided with apparatus permitting of determining the nature of the bodies by means of the different characters that distinguish them from each other.

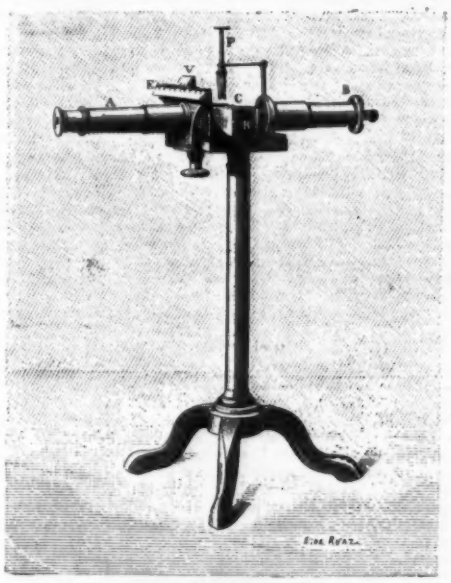
The weight and density give valuable data in this regard, but it was long ago pointed out that, with liquids particularly, the index of refraction is an important element. It is possible thus by means of simple laws to make a true optical analysis of organic compounds.

The bodies fraudulently introduced into commercial substances submitted to analysis are generally few in number and the measurement of the index of refraction is, up to a certain point, capable of giving the quantity of the adulterant with sufficient approximation.

The determination of the index of refraction may also be utilized by the chemist for the quantitative analysis of solutions.

The method generally employed for making measurements of this kind is that of the goniometer, but it is quite a lengthy and delicate one. Mr. Charles Fery has devised an apparatus of the same nature, but simpler, which he has had constructed by Mr. Pellin, and which is designed for the rapid measurement of the index of refraction of liquids. It is quickly set in operation and gives the result sought by the direct reading of a graduated scale. The principle of the apparatus consists in annuling, through a solid prism of variable angle and constant index, the deflection given a luminous ray by a hollow prism of fixed angle filled with the liquid whose index of refraction it is desired to know. The simple measurement of the displacement that it will have been necessary to effect in order to compensate for the deflection due to the liquid prism permits of reading such value directly.

In order to fulfill such conditions, Mr. Fery's apparatus consists of a collimator, B, provided with quite a wide slit carrying a vertical reticule. By means of a regulating screw it is possible to slightly displace the slit and reticule together for the regulation of the apparatus. Upon the same platform there is in the same axis an ordinary telescope, A, provided with two reticules. Between the two telescopes is placed a trough, C, whose two faces consist of two identical plates of glass, plane internally, convex externally, and making with each other quite a small angle. It is this trough that constitutes the liquid prism. It is upon a slide, R, that permits of a lateral displacement. In this rectilinear motion the slide carries along a vernier, V, which moves in front of a graduated scale, E. A clamp, P, permits of suspending a thermometer if it is desired to have the precise temperature of the liquid at the moment of the experiment.



FERY'S REFRACTOMETER.

In order to use the apparatus, there is allowed to fall upon the slit a ray of sodated monochromatic light, which is derived from a Bunsen burner, and which traverses the trough and is received by the telescope, A. When the trough is empty, this condition is fulfilled. When the vernier marks zero, the ray passing through the optical centers of the two lenticular plates is not deflected, but as soon as a liquid is introduced into C, there is a deflection of such ray. The trough is then moved upon the slide until a point is found where it reappears anew in the telescope, A. It is only necessary then to read upon the scale the displacement effected, and the graduation gives the index sought. We may remark that it is not necessary to fill the trough completely in order to make the measurement. It is even well to leave a certain space to afford facilities for verifying the zero during the experiment. In this case, the image of the reticule of the collimator does not disappear completely, but becomes weak solely.

The trough is capable of holding about 15 cubic centimeters, but the height of the liquid has no influence upon the result, and, if it covers the bottom by only a few millimeters, representing 2 cubic centimeters, that is sufficient to see the reticule and make a good measurement. This property of the apparatus is valuable in cases where it is necessary to operate upon rare liquids of which we possess but a small specimen.

We have supposed up to the present that the measurements were made with respect to the line of the sodated light for which the constant of the apparatus is made equal to unity; but if it were desired to operate with another light, it would be easy to calculate the new constant or determine it experimentally by means of a liquid whose index of refraction is known for the radiation employed. This new value of the constant is, however, always very near unity, and a table that accompanies the apparatus gives the figures for several lines of the spectrum. It is, however, so easy to employ the sodated light for which the instrument has been established that generally it will not be necessary to seek another constant.

In utilizing it just as it is, the apparatus is of simple management and will render great services in laboratories.—*La Nature.*

CULTIVATION OF COFFEE IN BRAZIL.

THE world's supply of coffee is estimated at 660,000 tons or over 11,220,000 bags of 132 pounds each, of which more than one-half comes from Brazil.

In 1891 the exports of coffee from Rio de Janeiro alone were 425,055,000, valued at $42,500,000 at 10 cents per pound. The exports from Santos are usually about one-half of those from Rio, and from these two ports the bulk of the coffee sent abroad is exported. The magnitude of the coffee growing interest in Brazil, and its importance in maintaining the national wealth and credit, may be estimated when it is considered that the United States alone paid to Brazil for her coffee in 1891 more than $45,000,000.

The profitable cultivation of coffee in Brazil is confined to the four states of Espiritu Santo, Minas Geraes, Rio de Janeiro and Sao Paulo. It is produced as far north as Para and in considerable quantities in Ceara, but the yield is less and the quality inferior to that of the product of the famous zone comprised in the four states just mentioned. The growth of coffee culture has been natural and remarkably rapid. No favors from the government, such as have been given to sugar production, no inducements to immigration on the part of national or state governments have contributed to the remarkable development of this great agricultural interest; but the natural adaptation of the soil and the growing demand for this staple have been sufficient to increase its exportation from thirteen bags in 1800 to the enormous quantities that annually load the vessels of all nations in the ports of Rio and Santos. The facilities for transportation from the interior to the coast have been a great factor in this increase, no doubt, as well as the moderate rates of freight on the railroads that have their termini in these ports.

The plantations are generally made on hillsides, from which the heavy forest growth has been cleared by felling the trees and burning off the undergrowth. The valuable logs are sometimes sawed on the spot into boards and planks; sometimes burned, after drying, and sometimes allowed to lie on the ground and decay. The latter method is perhaps the best, as the logs contain the wealth of the soil accumulated during years, which is thus returned to it again. As the cultivation is done altogether with hoe, spade and mattock, these decaying trunks are not so much in the way as might be supposed. All the vegetable growth that can be kept on the ground and does not interfere with the growing coffee trees aids in preventing the washing away of the mould from the soil, which a bare cultivation would carry off in a few years.

A plantation, properly managed, lasts for about thirty years in profitable bearing, and by that time the soil is worn out, as is attested by the many bald, red hills to be found in the older cultivated districts of the coffee zone.

The young plants are sometimes raised in seed beds, as described in speaking of coffee culture in Mexico; sometimes young shoots from the roots of old trees are employed, and sometimes the more expensive, but better, method is resorted to of raising each plant in a separate earthen pot, whence, at one year old, it is transplanted with all the earth about its roots to its permanent location. Long rows of these pots with their plants, set on a slope, over which water is constantly running, and protected from the hot rays of the sun by matting stretched on poles above them, may be seen on the plantations where the best methods are employed. The system is costly, but about a year is gained in the growth of the trees, and the plants, receiving no check by transplanting, rarely need replacing. It has been found advantageous also to select the very best grains for seed, and some planters have succeeded in establishing improved and distinct varieties, by repeated reproduction from the same kinds of seed.

Nowhere in the world is greater attention given to the cultivation and handling of coffee than in Brazil, and nowhere else is improved machinery for the preparation of the crop for market so generally employed. It is the fashion in praising the coffee of other countries to describe it as superior to the Brazilian, but no permanent advantage is gained by unjust comparisons, for they are against the facts. The truth is that no coffee anywhere in the world is superior to the Brazilian, which is sold everywhere as Java, Mocha, Maracaibo, etc., at the fancy of the dealer and whim of the consumer. Every plantation in the country produces the Java and Mocha of the markets of the United States, and it is only an affair of sieves of differently sized meshes to classify the products of Brazilian plantations into the falsely named kinds, in order to demand a higher price from the buyer. These facts cannot be controverted any more than can the other truth that no country produces coffee superior to that of Brazil. The coffee with a small, round grain, called, generally, "pea berry," and sold in the United States as "Mocha," is produced by topping and severely pruning the ordinary plant, although many such grains will always be found on trees treated in the usual manner.

While the young trees are growing, crops of corn or mandioca are sometimes raised between the rows, which are planted in the quincunx order, and these crops are sometimes sufficient to repay the expenses of the plantation. At the age of four years the trees are about six feet high and in profitable bearing. The principal gathering month is November, and then every available hand is engaged in picking the berries in baskets. The average result of a day's gathering for each person is enough to produce about fifty

pounds of dried coffee. The baskets are emptied of their contents into carts which convey the berries to the mill house, where they are to be prepared for market.

The berry resembles very closely the cranberry, and contains two grains with their flattened sides toward each other. Each of the two is covered with a closely adhering membrane called *pergaminho*, and outside of this is a thicker and more loosely fitting coat called *casquinho*. The two grains with their coverings are contained in a tough shell called *casco*, and this is surrounded by a white pulp and outer skin, thus forming the berry.

To prepare the coffee for market, all these coverings must be removed. The outer pulp is removed, after maceration in water, by a machine called *despolpador*, which consists of a revolving iron cylinder set with teeth and covered on one side by a concave sheet of metal.

A trough lined with cement is placed on a hillside above the mill, and through it a stream of water is kept running. Into this the coffee berries are thrown and are carried down by the stream into a large vat. In this vat the heavier berries sink to the bottom, whence they are drawn off through a pipe to the *despolpador*. This machine removes the pulp, the berries passing with the water to another vat beyond. In this the water is kept in constant motion by a revolving wheel, and the pulp is thus thoroughly washed off and carried away with the water, while the coffee grains sink to the bottom; and thence passing to a strainer the water is all drained off, leaving them ready for the process of drying.

Two methods of drying are in use; the old process, which consists in spreading the grains on a cement covered pavement called *terreiro*, where they are allowed to dry in the sun. For this about two months are necessary, and the grains have to be raked over and turned during the day and gathered into piles and covered at night. Whenever a shower comes up the coffee must also be covered. The more modern and satisfactory process of drying by steam is employed on many of the larger plantations. By this process the drying, which by the old method requires about sixty days, is accomplished in a few hours, with a vast economy of labor. Under this system drying is done in large, shallow pans of zinc heated by steam coils beneath. This process will, doubtless, on large plantations, supersede the older and more expensive method. The drying is done more uniformly and with no danger of injury from sudden rain.

The coffee, after drying, is still inclosed in the inner and outer skins, which have been rendered more brittle by the drying. The machinery necessary for the removal of these is somewhat complicated and expensive. The most efficient of the machines in use are from the United States, and a complete plant for a large plantation will cost not less than $25,000. The coffee is brought from the drying house and placed in bins, whence, by an elevator band, it is carried to a ventilator, where it is rid of rubbish and dust by sifting and fanning. From the ventilator the coffee is carried to the sheller (*descascador*), which consists of a toothed cylinder, by whose rapid revolutions the outer and inner husks are broken. The grains and broken husks are carried by a pipe to a second ventilator, where the latter are sifted out and fanned away, and the former are carried by an elevator to the separator. This is composed of hollow copper cylinders, pierced with holes of different shapes and sizes. These cylinders are kept constantly revolving, and the coffee grains, passing through the holes, fall into separate bins, being thus assorted according to their size and shape.

The coffee thus mechanically classified goes into the markets of the world, where it is sold, the small, round grains as Mocha, the large flat grains as Java, and so on, until all the coffee producing countries are represented in all the corner groceries of the world by the product of a single Brazilian plantation.

A small portion of the *pergaminho* which still remains is removed by the *brunidor* (polisher) by trituration and fanning. Finally, after passing through all this series of machines the coffee is carefully picked over by hand and is ready to be put into bags.

Although immense tracts of land suitable for coffee culture yet remain unoccupied, nearly all of them are held by large land owners who generally refuse to sell. As there is no tax on land and a considerable one on land sales, the owners prefer to hold them, as the constant demand for coffee lands annually enhances their value, and they can be held with no expense to their owners. Good coffee lands when sold bring large prices, and no person can engage in coffee raising without considerable capital. As has been said, the coffee zone embraces the states of Espiritu Santo, Rio de Janeiro, Minas Geraes and Sao Paulo, and the greater part of the unoccupied public lands are situated in the other states.

Under the new constitution of Brazil all wild lands formerly belonging to the empire are declared to be the property of the states within whose limits they lie, and their sale is governed by the various regulations established by the respective legislatures.

HOW RED SPIDER WAS GOT RID OF.

READERS of the *Gardeners' Chronicle* may probably remember my having strongly recommended the use of bricks for the covering of the surface of vine borders, both inside and out. The bricks should be merely laid on, without being either pointed in cement or mortar. I am still as great an advocate for the brick "dodge" as ever—not only because their protective presence brings the roots to the surface, where they can be readily and effectively fed with manurial stimulants, resulting in better grapes, and of a rich, blue-black color, which the brush of no artist could equal. What I most desire to set forth here is that by their use I have completely got rid of that—to gardeners—most troublesome pest, red spider. The summer now passed away being so unusually hot and dry, I have heard gardeners complain what a dreadful season it was for red spider. I am now, however, in a position and pleased to be able to say that the brick mulching, as adopted here, has brought about total immunity from this persistent, busy little tyrant of our houses, and specially so of our vineries and peacheries. In proof of my assertion, I send herewith a couple of leaves from our early peach house. From the time of starting the respective houses down to and long after the time of gathering the fruit, these bricks are kept always moist—wet, I might rather say. No dry dusty borders are ever allowed. Whether these insects lay their eggs in, and reproduce themselves among, the dry dust of the borders, I am not prepared to say; but having guessed as much, and having tried the antidote of perpetual wet bricks, I am now in a position to say that I have got rid of this disagreeable little lodger, who has, to our great grief, hurt, and annoyance, so long associated himself with almost every move of our indoor horticultural practice. The above refers only to what we call here our "long range" of vineries and peach houses. We have, besides, other two long lengths of peach cases, to which the brick cure has not yet been applied, in which I am bound to admit we have still a slight sprinkling of spider, notwithstanding all our efforts of constant and copious syringing. There is an old maxim, namely, that "Cleanliness is next to godliness." We should hoe where there are no weeds, smoke where there are no green fly, syringe where there are no red spider, and do all else imaginable where there is not even the ghost of a mealy bug. Young gardeners might do well for themselves by committing these rules to memory, and observing them in their daily practice. Modern technical education teaches many useful things, but these, too, ought to find a place in its curriculum. —*W. Miller, in Gardeners' Chronicle.*

EROSION OF THE MISSISSIPPI RIVER BANKS.

IN an interesting paper recently read before the American Society of Civil Engineers, Mr. J. A. Ockerson, M. Am. Soc. C.E., compares the recent accurate surveys of the Mississippi River, made since 1879, with an early reconnaissance, made in 1770, and with each other. He finds that the lateral motion of the river is very much less than is generally assumed, nearly every important bend now existing being represented in practically an identical position in the map of 1770, the changes in the river between that date and the more recent surveys being confined to a few cut-offs which occurred at known dates between the surveys. Apart from these the river flows round the same bends and between the same islands now as in 1770, its excursions into one side or other of its mean position being in general limited within a very narrow belt. Steps were taken in the 1879 survey, and since, to erect stone monuments at frequent intervals, forming permanent base points, by means of which it will be possible in future to determine changes in the bank line, and make accurate determinations of the rate of erosion of the bank. The ten years that have elapsed since the first of these accurate surveys have already enabled Mr. Ockerson to make a fair approximation to the rate at which the changes in the bank lines are now taking place. He remarks that erosion does not usually take place by the steady wearing away of the banks, but by caving, most of which occurs, not at high water, but during a falling stage of the river. The banks of the Mississippi for miles consist of sand and silt, with horizontal layers of clay at irregular intervals. The sand and silt become saturated during high water, and when the river level falls it carries with it the water which has penetrated the banks, undermining the latter. The result is that a block 200 ft. wide and about a mile long sometimes settles down bodily several feet. On a length of 885 miles between Cairo and Donaldsonville, there are 916 miles of caving banks, of which 430 miles are on the left hand bank, and the remainder on the right hand one. The erosion is practically continuous on one bank or the other for the whole distance, and, in general, erosion on one bank corresponds to accretion on the other, though the eroded areas overlap. The average annual erosion per mile of caving bank is about 42,000 cubic yards per annum. Of this total, less than one-third is carried away by the river, as proved by sediment observations on the water passing New Orleans.

THE GLACIERS OF GREENLAND.

A YEAR ago last summer the Berlin Geographical Society sent Dr. Drygalski and two or three assistants to Greenland to select a place on the southeast coast where a scientific party might spend a year to advantage in the study of the great glaciers. Dr. Drygalski selected a site in Umiak fiord, a little northeast of the island of Disco, and last year an expedition under his command went to the proposed scene of their labors. They erected their station at the foot of a rocky wall beside a fiord to which two glaciers descend, where all the conditions of the ice might be conveniently observed.

In September last Dr. Drygalski began his examination of the inland ice. To ascertain its movement fifty-seven bamboo poles were fixed to a depth of six and a half feet in the ice and their position astronomically determined. The temperature was recorded all last winter at depths down to twenty-nine and a half feet below the surface of the ground. The winter was particularly mild in West Greenland; in January last the mercury on several occasions rose above 50° F. and seldom fell below freezing point. The snowfall was also slight.

The sun disappeared Nov. 18. The polar night lasted sixty-eight days, but it did not interfere with labor as much as had been expected. The explorers were surprised to find that there was enough clearness at midday to enable them to dispense with artificial light. Peary found the conditions very different about eight hundred miles further north, where for several months a light was constantly burning night and day in his cabin.

The members of the expedition speak in the warmest terms of the friendliness and helpfulness of the natives whom they met before the winter night closed upon them and after the return of the sun. Dr. Drygalski devoted himself exclusively to glacial investigation and microscopic observation of the ice. Dr. Van Hoven confined himself to zoological studies, and Dr. Stade to the management of the meteorological station. Drygalski found that one of the glaciers he examined in 1891 had advanced about 3,500 feet in a year. The expedition is expected to reach home this month.

THE

Scientific American Supplement.

PUBLISHED WEEKLY.

Terms of Subscription, $5 a Year.

Sent by mail, postage prepaid, to subscribers in any part of the United States or Canada. Six dollars a year, sent, prepaid, to any foreign country.

All the back numbers of THE SUPPLEMENT, from the commencement, January 1, 1876, can be had. Price, 10 cents each.

All the back volumes of THE SUPPLEMENT can likewise be supplied. Two volumes are issued yearly. Price of each volume, $2.50 stitched in paper, or $3.50 bound in stiff covers.

COMBINED RATES.—One copy of SCIENTIFIC AMERICAN and one copy of SCIENTIFIC AMERICAN SUPPLEMENT, one year, postpaid, $7.00.

A liberal discount to booksellers, news agents, and canvassers.

MUNN & CO., Publishers,
361 Broadway, New York, N. Y.

TABLE OF CONTENTS.

Price 10 cents. For sale by all newsdealers.

PAGE

I. AGRICULTURE AND FARMING.—Cultivation of Coffee in Brazil.—Details of the Brazilian coffee crop and of the methods of raising the berry 14917
How Red Spider was Got Rid of.—How to get rid of the red spider, with useful axioms for the gardener 14919
Ice Houses.—How to make ice houses for farmers' use.—Practical suggestions 14919
II. BIOGRAPHY.—Benjamin Jowett.—The famous Balliol scholar.—His life work in classic studies, with portrait.—1 illustration 14920
Olive Mead.—A young violinist of great ability.—1 illustration 14919
III. CHEMISTRY.—A New Refractometer.—An instrument for use in the chemical laboratory for testing bodies by their indices and refraction.—1 illustration 14917
Experiments in Changes of Color with Reagents.—Some interesting experiments in chemical magic 14917
IV. CIVIL ENGINEERING.—Erosion of the Mississippi River Banks.—Rate of change in the bank lines of the Mississippi.—Methods by which the river does its work 14918
New Ferry Bridge and other Engineering Works at Bilbao, Spain.—A peculiar type of bridge construction, giving great elevation of span.—Another bridge by the same engineer.—7 illustrations 14920
Portland Cement.—The analysis of Portland cement.—Methods of testing its quality for use 14920
Roads of Italy and Spain.—The ancient roads of these countries and present condition of the same 14905
The Visit of the French Engineers to America.—Interesting account of the French engineers' visit to this country and of what they saw here 14907
V. COLUMBIAN EXPOSITION.—The Columbus Relics at the World's Columbian Exposition.—One of the most interesting exhibits of the World's Fair.—History of the collection shown there 14911
VI. ELECTRICITY.—Light and Electricity.—Variations in the transparency of platinum with heat.—Its relation to the electro-magnetic theory of light 14913
Measurement of the Electric Power of Alternating Currents.—Zipernowsky's electro-dynamometer for use with alternating currents.—1 illustration 14908
The Effect of Water Vapor on Electrical Discharges.—Interesting observations on effects of electrification on a steam jet 14913
VII. GEOGRAPHY.—The Glaciers of Greenland.—Examination of the inland ice of the Greenland continent.—Rate of motion of the glaciers 14919
VIII. MEDICINE.—Pilocarpine.—Its physiological action and therapeutic uses, with exhibition of specimens showing change in the color of the hair.—By D. W. PRENTISS, M.D.—Continuation of this most exhaustive paper, treating of general diseases in which the alkali is useful, of its action on the eye, and the antagonism between it and atropine 14904
Therapeutical Superstition.—By GEORGE T. WELCH, M.D.—A plea for advanced therapeutics.—The laborious field now open.—Fashion in medicine 14905
Treatment of Sea Sickness.—Treatment which has been found to be of some value, with formula 14906
Washing Out of the Intestinal Tract.—By Prof. ANTON VON GENERSICH.—The possibility of a complete irrigation of the intestinal tract.—How it is executed and its effects 14906
IX. NAVAL ENGINEERING.—The Cunard Company's Steamship Lucania.—Important report upon this ship.—An elaborate resume of her construction and appliances for lighting, signaling, etc. 14909
The Steering of Screw Propelled Vessels.—The theory of the method of steering screw propelled vessels in emergencies, especially applicable to the Camperdown-Victoria disaster.—4 illustrations 14905
X. PHOTOGRAPHY.—Diazotype Photography.—The so-called primuline process of taking photographs 14911
XI. TECHNOLOGY.—Laboratory Apparatus for the Distillation of Mercury.—The preparation of pure mercury on a small scale.—1 illustration 14904
Oxygen Gas as an Enrichment for Coal Gas.—An oxygen oil gas mixture for producing light.—A curious innovation in this field 14904

CATALOGUES.

A Catalogue of Valuable Papers contained in SCIENTIFIC AMERICAN SUPPLEMENT during the past ten years, sent *free of charge* to any address; also, a comprehensive catalogue of useful books by different authors, on more than fifty different subjects, has recently been published, for free circulation, at the office of this paper. Subjects classified with names of authors. Persons desiring a copy have only to ask for it, and it will be mailed to them. Address

MUNN & CO., 361 Broadway, New York.

PATENTS!

MESSRS. MUNN & CO., in connection with the publication of the SCIENTIFIC AMERICAN, continue to examine improvements, and to act as Solicitors of Patents for Inventors.

In this line of business they have had *forty-five years' experience*, and now have *unequaled facilities* for the preparation of Patent Drawings, Specifications, and the prosecution of Applications for Patents in the United States, Canada, and Foreign Countries. Messrs. Munn & Co. also attend to the preparation of Caveats, Copyrights for Books, Labels, Reissues, Assignments, and Reports on Infringements of Patents. All business intrusted to them is done with special care and promptness, on very reasonable terms.

A pamphlet sent free of charge, on application, containing full information about Patents and how to procure them; directions concerning Labels, Copyrights, Designs, Patents, Appeals, Reissues, Infringements, Assignments, Rejected Cases. Hints on the Sale of Patents, etc.

We also send, *free of charge*, a Synopsis of Foreign Patent Laws, showing the cost and method of securing patents in all the principal countries of the world.

MUNN & CO., Solicitors of Patents,
361 Broadway, New York.

BRANCH OFFICES.—Nos. 622 and 624 F Street, Pacific Building, near 7th Street, Washington, D. C.